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TECHNICAL INFORMATION BULLETIN 94-5

VIDEO TELECONFERENCING PERFORMANCE TESTING

DECEMBER 1994

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In recent years, with the onset of digital television processing and transmission, developments in television practices have rendered former methods of quality measurements of television signals as less accurate or applicable, as one would expect. In the past, quality measurements of analog television signals were easily vertified by use of video test signals that show amplitude and transient response, and for distortion freedom by differential gain and phase. In digital television systems, the advent of bandwidth compression has introduced techniques such as interframe coding which has created the need to identify objective measurements that can be used to accurately verify the quality of the video conducted by the particular digital system in use.

The purpose of this subtask is to investigate the results of subjective tests with objective tests made under the same conditions of a selection of video scenes that are considered typical of video telephony, video teleconferencing or entertainment video.

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NCS TECHNICAL INFORMATION BULLETIN 94-5

VIDEO TELECONFERENCING PERFORMANCE TESTING

DECEMBER 1994

PROJECT OFFICER

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FOREWORD

Among the responsibilities assigned to the Office of the Manager, National Communications System, is the management of the Federal Telecommunication Standards Program. Under this program, the NCS, with the assistance of the Federal Telecommunication Standards Committee identifies, develops, and coordinates proposed Federal Standards which either contribute to the interoperability of functionally similar Federal telecommunication systems or to the achievement of a compatible and efficient interface between computer and telecommunication systems. In developing and coordinating these standards, a considerable amount of effort is expended in initiating and pursuing joint standards development efforts with appropriate technical committees of the International Organization for Standardization, and the International Telecommunication Union - Telecommunication Standardization Sector. This Technical Information Bulletin presents an overview of an effort which is contributing to the development of compatible Federal, national, and international standards in the area of video teleconferencing. It has been prepared to inform interested Federal activities of the progress of these efforts. Any comments, inputs or statements of requirements which could assist in the advancement of this work are welcome and should be addressed to:

Office of the Manager
National Communications System
Attn: NT
701 S. Court House Road
Arlington, VA 22204-2198

TASK 3
TECHNICAL WORK IN THE AREA OF VIDEO TELECONFERENCING

SUBTASK 3
PERFORMANCE TESTING

FINAL REPORT
CONTRACT DCA100-91-C-0031
OPTION YEAR 3

Submitted to:
NATIONAL COMMUNICATIONS SYSTEM
ARLINGTON, VA

December, 1994

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1.0 INTRODUCTION

1.1 General

This document summarizes work performed by Delta Information Systems, Inc. (DIS) for the National Communication Systems (NCS), Office of Technology and Standards. The NCS is responsible for the management of the Federal Telecommunications Standards Program, which develops telecommunications standards, whose use is mandatory for all Federal departments and agencies.

This document is a final report for a Task Order on Contract DCA100-91-C-0031. The title for the contract and Task Order are listed below.

- Contract DCA100-91-C-0031
  Development of Federal Telecommunications Standard Relating to Digital Facsimile and Video Teleconferencing

- Task No. 3
  Technical Work in the Area of Video Teleconferencing

- Subtask No. 3
  Performance Testing

1.2 Background

In recent years, with the onset of digital television processing and transmission, developments in television practices have rendered former methods of quality measurements of television signals as less accurate or applicable, as one would expect. In the past, quality measurements of analog television signals were easily verified by use of video test signals that show amplitude and transient response, and for distortion freedom by differential gain and phase. In digital television systems, the advent of bandwidth compression has introduced techniques such as interframe coding which has created the need to identify objective measurements that can be used to accurately verify the quality of the video conducted by the particular digital system in use.

This effort is undertaken with funding from NCS as part of a continuing effort to establish standards for T1A1 for video information transmission. The

results of these efforts will also be available for general scientific use.

The purpose of this subtask is to investigate the results of subjective tests with objective tests made under the same conditions of a selection of video scenes that are considered typical of video telephony, video teleconferencing or entertainment video. The subjective tests are reviewed in detail in Section 2.0 of this report. The objective tests are reported in detail in Section 3.0 of this report.

DIS has developed a series of computer generated test patterns for objective testing. One objective test, the Scene Cut Response (SCR) is used exclusively in this report.

2.0 SUBJECTIVE TESTING

2.1 Executive Summary

The Subjective Testing reported herein is required by T1A1.5 to support development of transmission standards for Video Telephony and for Video Teleconferencing.

The method for accomplishing scene quality grading was by use of viewer reactions to numerous conditions affecting video coding quality. Three LABs collected viewer opinion of scene degradation with five levels of scoring the difference between an original scene and the same scene processed by a Hypothetical Reference Circuit (HRC), as follows: 5 - Imperceptible; 4 - Perceptible but not annoying; 3 - Slightly annoying; 2 - Annoying; or 1 - Very annoying.

Viewer impressions were screened for scoring accuracy through use of no degradation (nulls) and repeats. Those validated scores were summarized for statistical character and compared with two other Test LABs' results.

2.2 Test Location

The Subjective Testing portion of Performance Testing rendered by Delta Information Systems (DIS) was one of three sites collecting viewer reaction to test scenes. These three Test Sites are identified as LAB X (Delta Information Systems/National Communications System), LAB Y (GTE), and LAB Z (Department of Commerce/National Telecommunications & Information Administration/Institute for Telecommunications Sciences).

Since LAB X was to be supplied with viewers from the Washington, D.C., area, the selection of the test location was necessarily in the Washington, D.C., vicinity. Many possible sites were poor seconds to the "Expert Viewing Room" at Advanced Television Testing Center, 1330 Braddock Place, Alexandria, Virginia. That facility maintained viewing conditions in accordance with CCIR Recommendation 500-5 and was outfitted with much desired secondary support equipment as well as a solid technical staff. Also, other candidate test locations would have required considerable effort to comply with the CCIR Recommendation 500-5.

2.3 Test Video Tape Details

The source of video used for Subjective Testing was the result of a set of still images from 25 scenes, as shown in Appendix A. These 25 scenes represent five categories that are typical of video telephony, video teleconferencing, and entertainment video. These categories cover a wide range of movement and detail. Each scene is edited to a length of nine seconds. These categories are:

a. one person, mainly head and shoulders (scenes f, j, k, l);
b. one person with graphics and/or more detail (scenes a, s, e, m, n, w);
c. more than one person (scenes d, g, o, p, q, r);
d. graphics with pointing (scenes c, s, t, u, v, w);
e. high object and/or camera motion (scenes h, i, y).

Also included on the scene tapes are candidate objective test patterns of the rotating wheel and three-size dot patterns. Each set of scenes is processed by HRCs chosen to span a broad range of video quality. The 25 HRCs represented the following categories. These systems cover a range of bit rates from 112 Kb/s to 70 Mb/s. These categories are:

GROUP NO.	CIRCUIT DESCRIPTION	HRC NO.
1	High quality	1 - 3
2	Vector quantization, medium rate	4, 5
3	Proprietary, low to medium rate	6, 7
4	Proprietary, medium to high rate	8 - 10
5	QCIF, low rate	11 - 13
6	QCIF, medium rate	14
7	CIF, low rate	15 - 18
8	CIF, medium rate	19 - 21
9	CIF, high rate	22 - 25

All were recorded on Beta Cam D2 format.

From these video recordings, three sets of four tape recordings were generated, following the explanation in the Subjective Test Plan, Appendix B (T1A1.5/94-118R1 attached), to provide a balanced set of video scenes for subjective test viewing. These tapes are identified as for viewing by the Red, Green, or Orange Team. The scene content sequence of each tape is shown in the Subjective Test Plan. It is noted that a viewer will see scenes as processed by a restricted number of HRCs. It is also noted that all viewers will see scenes processed by HRC 20 and that HRCs 4, 15, and 17 are viewed by two of the three teams.

2.4 Viewer Scheduling

Viewers recruited for the subjective testing conducted by DIS were organized by the management of NCS from Federal Departments in the vicinity of Washington, D.C. The initial call for volunteers for the subjective test yielded approximately one-half of the desired number of participants. With the test studio schedule pressing a start, the recruiting effort was continued with use of the Equivalent Method of Viewer Randomization put into use. Those who expressed interest in the program supplied an availability forecast which was the basis for LAB X Team assignments.

Viewers were usually scheduled for two tape plays in a two-hour period. Occasionally, just one tape was viewed. It was virtually impossible to maintain a team schedule due to the viewer availability. A practice tape was presented prior to viewing the scheduled tapes. Viewers were seated in the "Expert Viewing Room," as shown in Figure 2.1. Data sheets for each tape play were annotated by the viewer for their opinion of each presented scene. A fifteen-minute break was included between tapes for those viewing two consecutive plays. (See Test Plan, Appendix B.)

It was necessary to revise the viewing schedule daily for nearly the entire test period. A total of 46 individuals were scheduled for viewing. Thirty-eight of these actually saw tapes. Three of these saw only 2 of the 4 tapes. Only five viewers failed the null check, resulting in 30 qualified viewer completions - 10 for each Team. Demographic data for the 35 viewers scoring 4 tapes is shown in Table 2-1. See Table 2-2 for the final completed viewing schedule.

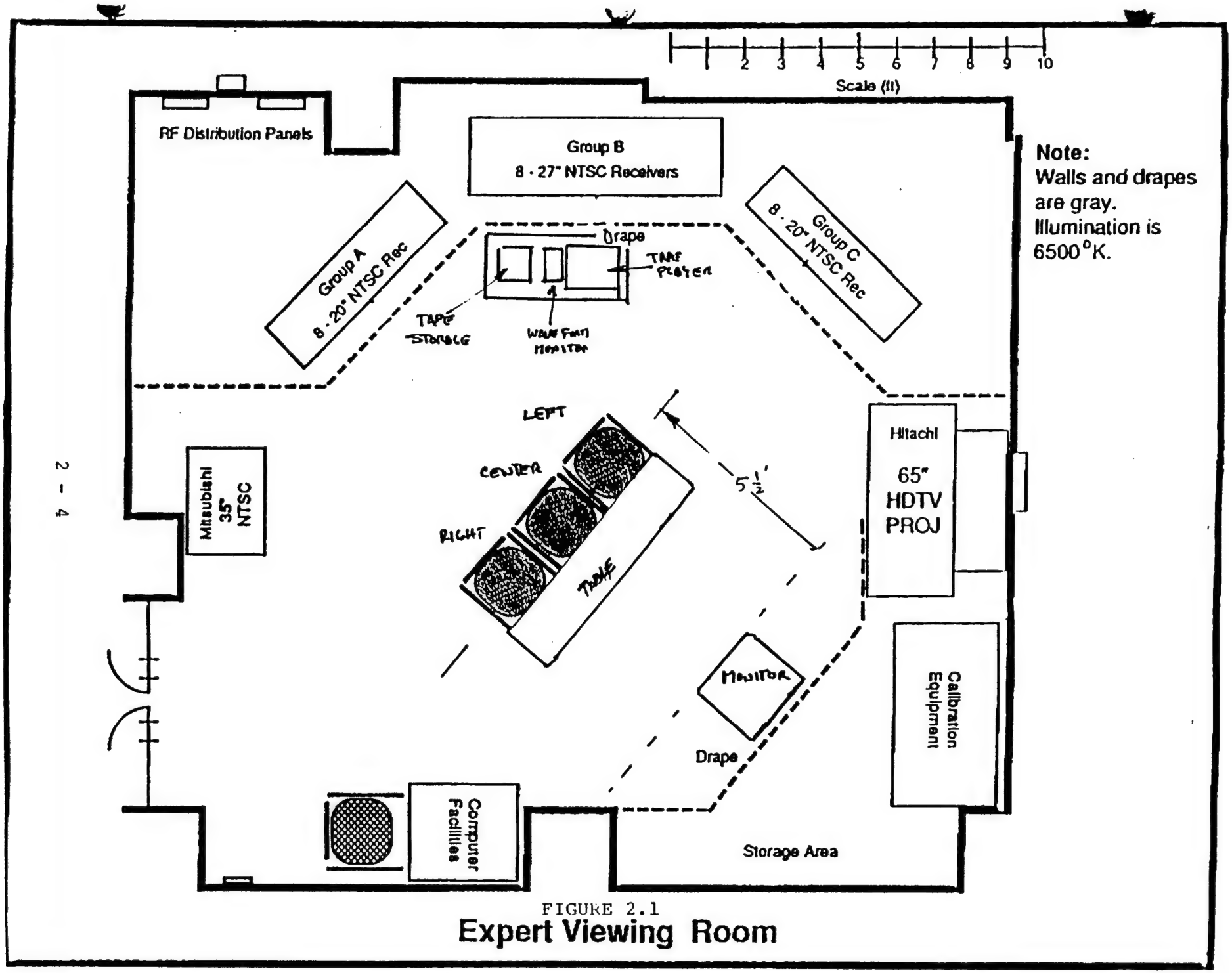

FIGURE 2.1
Expert Viewing Room

TABLE 2-1 DEMOGRAPHIC FILE

RED TEAM

ID	DECADE	GENDER	INDUSTRY	JOB	PAST VIDEO	EYE TEST	SEAT	SESSION ORDER
01x	40	female	Government	Technical	Recent	7/2	center	2143
09x	30	female	Broadcasting Newspapers	Professional	No	7/3	right	1234
11x	40	male	Government	Professional	Recent	7/4	left	1234
26x	30	male	Government	Professional	No	8/2	right	2431
33x	40	female	Government	Professional	No	7/4	left	2134
24x	30	male	Government	Technical	No	7/2	right	1243
29x	40	male	Government	Professional	No	8/3	center	1342
30x	30	male	Government	Professional	Yes	9/0	center	1423
31x	30	male	Government	Technical	No	9/1	left	3412
35x	20	male	Government	Professional	Recent	7/0	right	3412
40x	50	female	Government	Secretarial	No	7/4	left	1234
17x	50	male	Government	Administrative/ White Collar	No	6/1	center	1342
41x	20	male	Telecommunication/ Utilities	Professional	No	7/0	right	3412

GREEN TEAM

ID	DECADE	GENDER	INDUSTRY	JOB	PAST VIDEO	EYE TEST	SEAT	SESSION ORDER
08x	30	female	Government	Administrative/ White Collar	Recent	7/3	left	1423
23x	30	male	Government	Executive/ Managerial	No	7/1	right	1432
14x	60	male	Government	Executive/ Managerial	Yes	10/1	center	1432
10x	60	male	Government	Professional	Yes	8/3	right	2134
27x	40	male	Government	Technical	Recent	7/1	left	2134
04x	30	male	Telecommunication/ Utilities	Owner/ Operator	No	6/3	left	1432
12x	30	female	Government	Secretarial	No	7/1	center	3214
25x	20	male	Government	Professional	No	10/1	center	3214
34x	50	male	Electronics/	Professional	Recent	7/4	left	3214

03x	30	male	Computers Government	Technical	Recent	9/1	center	1432

ORANGE TEAM

ID	DECADE	GENDER	INDUSTRY	JOB	PAST VIDEO	EYE TEST	SEAT	SESSION ORDER
02x	60	male	Government	Professional	No	6/4	right	3421
06x	50	male	Government	Executive/ Managerial	Recent	6/4	right	1423
07x	50	female	Government	Administrative/ White Collar	No	7/4	left	4321
15x	20	male	Government	Professional	Recent	8/0	right	2314
20x	30	female	Government	Clerical/ Support	No	10/1	right	4321
21x	60	male	Government	Technical	No	7/1	center	4321
22x	20	female	Government	Professional	No	8/0	left	3214
28x	40	male	Government	Administrative/ White Collar	Yes	7/4	center	4231
37x	20	male	Government	Professional	No	10/0	left	4213
38x	20	female	Government	Secretarial	No	8/1	center	4231
32x	50	male	Government	Executive/ Managerial	No	7/4	center	1423
36x	20	male	Government	Technical	No	6/3	center	4231

2.5 Test Procedure

2.5.1 Equipment

After the dispatch of required equipment and other material to the Advanced Television Test Center, the test video system was assembled and calibrated for the test condition requirements of CCIR Recommendation 500-5 and the Subjective Test Plan. The video equipment remained powered for the entire duration of subjective testing to avoid the level drifting that was noted for the first two hours following the initial cold start.

TABLE 2-2

FINAL SCHEDULE

SUBJECTIVE SCHEDULE MAY 26

DAY	HOUR	TAPE	L	C	R
MON 25	9				
	10				
	11	03	DIXON	BRACKNEY	SAVOYE
	12	04	DIXON	BRACKNEY	SAVOYE
	13	G3	LOPEZ	POOLE	
	14	G2	LOPEZ	POOLE	
	15				
	16				
	17				
TUES 26	9	G1	LOPEZ	CHAMPION	
	10	G4	LOPEZ	CHAMPION	
	11	R1		BARR	
	12	R3		BARR	
	13	R1		JAMIL	
	14	04	ORNDORFF	MCCLELLEN	LABONTE
	15	03	ORNDORFF	MCCLELLEN	LABONTE
	16				
	17				
THUR 28	9	G1	TART		SELISKAR
	10	G4	TART		SELISKAR
	11	01	OLDEN	RYAN	
	12	04	OLDEN	RYAN	
	13	R4	BARR		JAMIL
	14	R2	BARR		JAMIL
	15	G3	TART		SELISKAR
	16	G2	TART		SELISKAR
	17				
FRI 29	9	G1	TROTTA	CHRISTENSEN	
	10	G4	TROTTA	CHRISTENSEN	
	11				
	12				
	13				
	14				
	15				
	16				
	17				
MON 2	9	04		BAIN	NGUYEN
	10	02	NGUYEN		BAIN
	11	R1	MONAHAN		MENKE
	12	R2	MONAHAN		MENKE
	13	02		SAVOYE	
	14	01		SAVOYE	
	15	02		MCCLELLEN	
	16	03		BAIN	
	17				

TABLE 2-2 con't.

TUES 3	9	R2		MOORE	THOMPSON
	10	R1		MOORE	THOMPSON
	11	O3		NGUYEN	
	12	O1		NGUYEN	
	13	R1		KARTY	
	14	R3		KARTY	
	15	R3	SCHMITZ	MENKE	RAINES
	16	R4	SCHMITZ	MENKE	RAINES
	17				
WED 4	8	G2		TROTTA	
	9	G2	WILSON		BAKER
	10	G1	WILSON		BAKER
	11	O1			
	12	X			
	13	X			
	14	X			
	15	X			
	16	X			
	17	X			
THUR 5	8	G3		TROTTA	
	9	R4		KARTY	
	10	R2		KARTY	
	11	R4		MOORE	
	12	R3		MOORE	THOMPSON
	13	O2	ORNDORFF		O'CONNOR
	14	O3		CAPPEL	O'CONNOR
	15	R1		SCHMITZ	
	16	R2		SCHMITZ	
	17				
FRI 6	9	X			
	10	X			
	11	X			
	12	X			
	13	X			
	14	X			
	15	X			
	16	X			
	17	X			
MON 9	9	O2		CAPPEL	LABONTE
	10	O1	CAPPEL	BAIN	LABONTE
	11	G2			
	12	G3			
	13	R3		MONAHAN	
	14	R4		MONAHAN	
	15	X			
	16	X			
	17	X			
TUES 10	9	G3	CHAMPION	KERR	CHRISTENSEN
	10	G2	CHAMPION	KERR	CHRISTENSEN
	11	R3		JAMIL	
	12	O1		MCCLELLEN	
	13	G3		WILSON	BAKER
	14	G4		WILSON	BAKER
	15	X			
	16	X			
	17	X			

TABLE 2-2 con't.

WED 11	9	G1			
	10	G4			
	11	R2			
	12	R1			
	13	G2			
	14	G1	KERR		
	15	O4	OWENS	QUINN	
	16	O2	OWENS	QUINN	
	8	O3	QUINN		
THURS 12	9	O1	OWENS	O'CONNOR	QUINN
	10	R1	PERSCHAU		
	11	R2	PERSCHAU		
	12	R2	BRUSH		
	13	O3	OWENS		
	14	G1	POOLE		
	15	G4	KERR	POOLE	
	16				
	17				
	8	O4	O'CONNOR	CAPPEL	
FRI 13	9	O2		RYAN	OLDEN
	10	O3		RYAN	OLDEN
	11	R4	BRUSH	THOMPSON	PERSCHAU
	12	R3	BRUSH		PERSCHAU
	13	O1	ORNDORFF		
	14	R1	RAINES	GRAY	NGUYEN
	15	R2	RAINES	GRAY	NGUYEN
	16	R1	BRUSH		
	17				
WED 18	9	R3	GRAY	BAE	
	10	R4	GRAY	BAE	
	11				
	12				
	13				
	14				
	15				
	16				
	17				
THUR 26	9				
	10	R1	BAE		
	11	R2	BAE		
	12				
	13				
	14				
	15				
	16				
	17				

Video equipment for viewing the test tapes was provided by Sony Electronics, consisting of a Broadcast Television Monitor, Model BVM1911, and a Betacam SP Tape Player, Model PVW2600. Calibration of the video equipment was done each day prior to scheduled viewing, consisting of checks of the tape player output amplitude (white = 714 IEEE units), monitor white balance (6500 degrees K), monitor peak white brightness (70.0 cd/square meter), and monitor chroma balance. The initial setup of the video equipment was facilitated by use of a Betacam Video Test Signal Generator, Tektronix Model TSG130A, and a Video Waveform Monitor, Tektronix Model WFM300A. Monitoring of all tape plays with the WFM300A was done by the test conductor to assure normal video production.

2.5.2 Color Perception

Following the completion of tape viewing, vision screening checks were made, if required. Color perception checks were made with use of "Pseudo-Isochromatic Plates for Color Perception," made by Richmond Products, 1021 Rogers Circle, Boca Raton, Florida, which test for red-green color defects. These color checks were performed in the "Expert Viewing Room" with the room illumination at maximum level. The room illumination is D65, which is required for viewing the color plates. A score sheet was marked by the viewer and retained for recording purposes. Normal color vision was considered to be missing no more than 4 of the 14 color plates. Of the 38 viewers tested, two did not demonstrate normal color vision.

2.5.3 Visual Acuity

Visual acuity checks were next made, if required, prior to releasing the viewer. These were done with a normal eye chart reduced in size for viewing at 5.5 feet, as distributed by NTIA. Viewers were expected to exhibit no errors on line 7. For the first two days, viewers were tested in the standing position. Several viewers confused the first character of line 7, recognizing it as a "P" rather than an "F". Viewers were then checked in a sitting position, with consistently better results for the remaining days of the test. When possible, viewers were later rechecked in the sitting position and generally passed the test. Because it was not possible to recheck all viewers, the SUMMARY program was modified to not disqualify viewers that had no errors only on line 6, since it was felt that all the viewers had normal visual acuity.

2.5.4 Vision Summary

Table 2-1 shows the demographic data accumulated on the viewers. Under EYE TEST, the first number indicates the line of the acuity chart that was read with no errors; the second number indicates the number of color charts missed. This shows that 5 viewers only read line 6 of the acuity chart with no errors and that 6 viewers read all color plates correctly.

2.5.5 Viewing Position

It was not realized that it was required that each viewer be assigned the same seat at each session. This requirement is stated only in Appendix G of the Subjective Test Plan. Adhering to this requirement would have added to the scheduling difficulties already presented by the availability of viewers and maintaining a team schedule. The SUMMARY program would not accept the absence of a single seat designation in the demographic data. Therefore, a seat was inserted for this item (generally that of the majority or the first session). In addition, the WordPerfect file "SEATS" was generated which shows the seats used by each viewer in each session, shown in Table 2-3. This file should be used if statistical tests on the effect of viewing position are performed.

2.5.6 Viewing Order

Because of scheduling difficulties, it was also not possible to schedule the planned order for viewing tapes. Note that for each team, there are 24 possible sequences of the four tapes. Four of these sequences were assigned to each of the three LABs; so, at most, only 12 of the 24 orders were scheduled. See Table 2-4 for the distribution of viewing sequences for the three LABs and for the accomplished viewing sequences done by the viewers conducted by LAB X. Letters X, Y, and Z indicate the planned orders. The numbers underneath indicate the total number of viewers at LAB X for each team. Those numbers in brackets indicate the number of qualified viewers if less than the total viewers. Numbers not under an X indicate viewers whose sequence was not according to the schedule.

TABLE 2-3 ACTUAL SEATS USED BY VIEWERS

The following are the seats used by the viewers. They are listed in the chronological order in which they viewed the tapes, not by the tape number.

VIEWER	SESSION 1	2	3	4
01x	c	c	c	c
02x	r	r	c	c
03x	c	c	r	l
04x	l	l	l	l
05x				
06x	r	r	r	l
07x	l	l	c	c
08x	l	l	c	c
09x	r	r	c	c
10x	r	r	r	r
11x	l	c	c	c
12x	c	c	c	c
13x				
14x	c	c	r	r
15x	r	r	l	r
16x				
17x	c	c	l	l
18x				
19x				
20x	r	r	r	r
21x	c	c	c	c
22x	c	l	l	c
23x	r	r	r	r
24x	r	r	l	l
25x	c	c	c	r
26x	l	r	r	c
27x	l	l	c	c
28x	c	r	c	c
29x	c	c	c	c
30x	c	r	r	c
31x	l	l	c	c
32x	c	c	l	l
33x	l	l	l	c
34x	l	l	l	l
35x	r	r	c	c
36x	r	l	c	c
37x	l	l	r	c
38x	c	c	c	c
39x				
40x	l	l	l	l
41x	r	r	c	c

TABLE 2-4 DISTRIBUTION OF VIEWING SEQUENCES

1234	1243	1324	1342	1423	1432	2134	2143	2314	2341	2413	2431
RED											
x			x			y	x	yy		z	z
3	**1**		2	1(0)		1(0)	1				**1**
GREEN											
	z		y	x	x	x			z		z
				1	4	2					
ORANGE											
y		z		x						y	
				2				**1**			

3124	3142	3214	3241	3412	3421	4123	4132	4213	4231	4312	4321
RED											
	yz			x					z		
				3(2)							
GREEN											
y		x		y				y			z
		3									
ORANGE											
y			z		x	y	z		x	z	x
		1			1			**1**	3(2)		3(2)

Five otherwise qualified viewers (15x, 22x, 24x, 26x, and 37x) viewed the tapes in an order that was not in the original plan. Only one of these unplanned orders coincided with that of the same team of another LAB, so diversity of order was increased.

2.6 Data Collection

Original test data sheets were marked by the viewer, showing the scheduled time and date as well as the actual time and date of each tape play. Each scene of each tape has space assigned for the viewer to mark one of five opinion grades as shown in the test plan. Included in each tape sequence are nulls and repeats. A null is a scene with no degradation; a repeat is an identical, same scene/HRC combination for the second time in a session. These nulls and repeats were checked following the completion of the viewing period which identified probable invalid data to facilitate subsequent viewer scheduling. Original data sheets are on file at Delta Information Systems.

2.6.1 Missed Repeats

Of the 9,030 scene combinations to be marked by all viewers, 11 were missed, either because no score, or more than one score, was marked. For two viewers, 09x and 27x, one of the missed scores was the second repeat. According to the Subjective Test Plan, these viewers should be disqualified because they missed a quality check combination. However, 27x scored every null and all other repeats correctly. The score on the first repeat was 4, so only a 1 on the second repeat would be disqualifying otherwise. The repeat in question was not marked, and the previous scene had two scores: 3 and 5. The situation for 09x was similar in that every null was correct, and the other repeats were scores differing no more than 1. The first repeat score was 4, and the second repeat was scored both 3 and 5. It was felt that this should not disqualify the viewer since the repeat score does not count towards the result. Therefore, the SUMMARY program was modified so that these viewers were not disqualified.

2.6.2 Missed Scores

For another viewer, 10x, one score was missed on each of three tapes. According to the Subjective Test Plan, this viewer should be disqualified for missing more than two scores. Viewer 09x had a similar situation in missing two scores on one and one score on another tape. Apparently, the SUMMARY program does not check for this.

2.6.3 Null Checks

Five viewers (07x, 30x, 31x, 33x, and 36x) were disqualified because of the null check. Both 07x and 36x missed two nulls, with 36x giving a score of 2 to a null. The scenes missed were t (three times), s (two times), c, and h. No viewers failed the repeat check, and only 8 of 140 repeat had a difference as large as 2.

2.7 Data Reduction

Data sheets collected during the viewing series were entered into a data file and verified by a second data entry with comparison. Seventeen entry errors of the first data files were corrected by the check method. The scores of the 38 viewers that were processed in the viewing program were reduced by 5 failing the accuracy checks, 2 incompletes due to lack of desired color perception, and 1 that

was not able to complete the four-tape series. The 30 satisfactory scores were equally distributed among the three color teams.

These scores were processed by the SUMMARY program developed by the National Telecommunications & Information Administration. This program calculates the Mean Opinion Score (MOS) of each scene (a to y) for all HRCs (1 to 25). Also calculated are SD (estimate of standard deviation of observer population) and SE (estimate of standard error of mean) for all. The Maximum (largest observed opinion score) and Minimum (smallest observed opinion score) scores are also shown for all. This data is shown in Table 2-5.

MOS for Scene/HRC of another LAB is shown in Appendix C for LAB Z (Department of Commerce/National Telecommunications & Information Administration/Institute for Telecommunications Sciences).

2.8 Final Data Details

All test participants of teams viewed and scored scenes processed by HRC 20, as well as scenes d and s processed by various HRCs. Figure 2.2 shows the scores of the NCS/DIS program compared with scores reported from the NTIA program for HRC 20. Figures 2.3 and 2.4 show comparisons of scores also reported by the same programs for scenes d and s. Figures 2.5, 2.6, and 2.7 show the same data but comparing LAB Y (GTE) against the Delta data.

The plot of MOS comparing the results for two LABs would be in complete agreement when the data point falls on the dotted line. For nearly all scenes, the MOS LAB-to-LAB agreement is quite close.

TABLE 2-5 SUMMARY OF RESULTS

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
1	MEAN	4.90	5.00	4.80	4.90	5.00	4.90	4.80	5.00	4.80	4.90	5.00	5.00	5.00
	S.D.	0.32	0.00	0.42	0.32	0.00	0.32	0.42	0.00	0.63	0.32	0.00	0.00	0.00
	S.E.	0.10	0.00	0.13	0.10	0.00	0.10	0.13	0.00	0.20	0.10	0.00	0.00	0.00
	MAX	5	5	5	5	5	5	5	5	5	5	5	5	5
	MIN	4	5	4	4	5	4	4	5	3	4	5	5	5

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
2	MEAN	4.80	4.20	4.20	4.40	4.70	4.20	4.60	4.20	4.50	4.10	4.60	4.80	4.67
	S.D.	0.42	0.63	0.92	0.70	0.48	0.42	0.52	0.63	0.53	0.57	0.52	0.42	0.50
	S.E.	0.13	0.20	0.29	0.22	0.15	0.13	0.16	0.20	0.17	0.18	0.16	0.13	0.17
	MAX	5	5	5	5	5	5	5	5	5	5	5	5	5
	MIN	4	3	3	3	4	4	4	3	4	3	4	4	4

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
3	MEAN	4.90	4.70	4.80	4.80	4.90	4.80	4.90	4.70	4.90	4.90	4.90	4.50	4.90
	S.D.	0.32	0.67	0.42	0.42	0.32	0.42	0.32	0.48	0.32	0.32	0.32	0.53	0.32
	S.E.	0.10	0.21	0.13	0.13	0.10	0.13	0.10	0.15	0.10	0.10	0.10	0.17	0.10
	MAX	5	5	5	5	5	5	5	5	5	5	5	5	5
	MIN	4	3	4	4	4	4	4	4	4	4	4	4	4

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
4	MEAN	3.00	2.60	2.45	2.45	2.15	3.25	2.85	2.25	1.45	3.10	3.15	3.55	1.85
	S.D.	0.79	0.94	1.05	0.89	1.04	0.72	0.81	0.91	1.00	0.85	0.99	0.69	0.81
	S.E.	0.18	0.21	0.23	0.20	0.23	0.16	0.18	0.20	0.22	0.19	0.22	0.15	0.18
	MAX	4	4	5	4	4	4	4	4	5	4	5	5	3
	MIN	2	1	1	1	1	1	1	1	1	1	1	2	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
5	MEAN	3.60	3.20	3.30	3.20	3.40	4.10	3.20	2.90	1.60	3.80	3.90	4.10	2.90
	S.D.	0.70	0.79	0.95	0.79	0.97	0.57	0.92	0.74	0.52	0.63	0.88	0.32	0.57
	S.E.	0.22	0.25	0.30	0.25	0.31	0.18	0.29	0.23	0.16	0.20	0.28	0.10	0.18
	MAX	5	4	5	4	5	5	4	4	2	5	5	5	4
	MIN	3	2	2	2	2	3	2	2	1	3	3	4	2

TABLE 2-5 con't.

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
6	MEAN	3.70	2.50	2.90	2.50	2.20	4.20	3.00	1.70	1.20	2.70	3.70	3.70	1.70
	S.D.	0.82	0.71	0.99	1.18	1.14	0.42	0.82	0.67	0.63	0.67	0.48	0.67	0.48
	S.E.	0.26	0.22	0.31	0.37	0.36	0.13	0.26	0.21	0.20	0.21	0.15	0.21	0.15
	MAX	5	4	4	5	4	5	4	3	3	4	4	5	2
	MIN	2	2	1	1	1	4	2	1	1	2	3	3	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
7	MEAN	3.70	3.00	2.90	3.20	3.44	3.60	3.20	3.10	2.20	3.70	3.70	3.60	2.30
	S.D.	0.82	0.82	0.99	1.14	0.88	0.84	0.92	0.74	0.79	0.67	0.82	0.84	0.95
	S.E.	0.26	0.26	0.31	0.36	0.29	0.27	0.29	0.23	0.25	0.21	0.26	0.27	0.30
	MAX	5	4	4	5	4	5	4	4	3	4	5	5	4
	MIN	2	1	1	1	2	2	1	2	1	2	2	2	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
8	MEAN	4.00	3.50	2.70	3.60	3.40	3.70	3.80	3.00	2.50	4.20	3.90	4.20	3.50
	S.D.	0.67	0.97	1.06	0.84	1.07	0.95	0.63	1.15	0.71	0.92	0.88	0.63	0.85
	S.E.	0.21	0.31	0.33	0.27	0.34	0.30	0.20	0.37	0.22	0.29	0.28	0.20	0.27
	MAX	5	5	4	5	4	5	5	4	4	5	5	5	4
	MIN	3	2	1	2	1	2	3	1	2	2	2	3	2

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
9	MEAN	4.70	3.30	2.60	3.40	3.50	4.50	4.00	2.60	2.20	3.90	4.20	4.10	2.60
	S.D.	0.48	0.67	0.52	0.84	0.53	0.53	0.67	0.84	0.79	0.57	0.63	0.74	0.70
	S.E.	0.15	0.21	0.16	0.27	0.17	0.17	0.21	0.27	0.25	0.18	0.20	0.23	0.22
	MAX	5	4	3	4	4	5	5	4	3	5	5	5	4
	MIN	4	2	2	2	3	4	3	1	1	3	3	3	2

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
10	MEAN	4.90	4.00	3.20	3.67	3.60	4.90	4.40	3.40	2.80	4.60	4.80	4.60	4.00
	S.D.	0.32	0.67	0.63	0.50	0.70	0.32	0.52	0.70	0.63	0.52	0.42	0.52	0.50
	S.E.	0.10	0.21	0.20	0.17	0.22	0.10	0.16	0.22	0.20	0.16	0.13	0.16	0.17
	MAX	5	5	4	4	5	5	5	4	4	5	5	5	5
	MIN	4	3	2	3	3	4	4	2	2	4	4	4	3

TABLE 2-5 con't.

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
11	MEAN	3.00	3.10	1.70	2.20	1.80	3.10	2.20	1.60	1.40	1.70	2.60	2.20	1.40
	S.D.	0.82	0.57	0.67	0.79	0.79	0.88	0.79	0.84	0.70	0.67	0.70	0.92	0.70
	S.E.	0.26	0.18	0.21	0.25	0.25	0.28	0.25	0.27	0.22	0.21	0.22	0.29	0.22
	MAX	4	4	3	3	3	4	4	3	3	3	4	4	3
	MIN	2	2	1	1	1	2	1	1	1	1	2	1	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
12	MEAN	2.60	1.90	1.70	1.90	1.50	2.90	2.50	1.90	1.30	2.20	2.30	3.00	1.30
	S.D.	0.84	0.74	1.06	0.88	0.71	0.99	1.08	0.88	0.48	0.63	0.95	0.82	0.48
	S.E.	0.27	0.23	0.33	0.28	0.22	0.31	0.34	0.28	0.15	0.20	0.30	0.26	0.15
	MAX	4	3	4	3	3	4	4	3	2	4	4	4	2
	MIN	1	1	1	1	1	2	1	1	1	2	1	2	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
13	MEAN	1.90	1.60	1.60	2.20	1.80	2.60	2.20	2.20	1.80	2.40	2.60	3.00	2.00
	S.D.	0.74	0.84	0.52	0.79	0.79	0.97	1.23	1.03	0.92	0.84	1.07	0.94	0.67
	S.E.	0.23	0.27	0.16	0.25	0.25	0.31	0.39	0.33	0.29	0.27	0.34	0.30	0.21
	MAX	3	3	2	3	3	4	4	4	3	4	4	4	3
	MIN	1	1	1	1	1	1	1	1	1	1	1	1	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
14	MEAN	2.10	2.70	2.10	2.40	1.90	2.80	1.90	2.40	2.20	3.30	3.00	3.30	3.20
	S.D.	0.88	1.34	0.99	1.07	0.88	0.92	0.88	0.97	0.63	0.67	0.82	0.95	0.63
	S.E.	0.28	0.42	0.31	0.34	0.28	0.29	0.28	0.31	0.20	0.21	0.26	0.30	0.20
	MAX	4	5	4	4	3	4	3	4	3	4	4	5	4
	MIN	1	1	1	1	1	2	1	1	1	2	2	2	2

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
15	MEAN	2.80	2.40	1.55	2.10	1.35	3.10	2.50	1.95	1.55	2.05	2.95	2.40	1.70
	S.D.	0.77	0.94	0.76	0.85	0.67	0.97	0.89	0.83	0.69	0.83	0.89	0.94	0.66
	S.E.	0.17	0.21	0.17	0.19	0.15	0.22	0.20	0.18	0.15	0.18	0.20	0.21	0.15
	MAX	4	4	3	4	3	5	4	3	3	4	4	4	3
	MIN	2	1	1	1	1	1	1	1	1	1	1	1	1

TABLE 2-5 con't.

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
16	MEAN	3.40	3.20	2.90	2.56	1.90	3.30	2.40	2.30	1.10	1.80	2.60	3.30	1.40
	S.D.	0.97	0.63	1.37	0.88	0.74	1.06	0.70	0.95	0.32	0.63	0.70	0.82	0.52
	S.E.	0.31	0.20	0.43	0.29	0.23	0.33	0.22	0.30	0.10	0.20	0.22	0.26	0.16
	MAX	4	4	5	4	3	5	4	4	2	3	4	5	2
	MIN	1	2	1	1	1	2	2	1	1	1	2	2	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
17	MEAN	3.65	3.05	2.45	2.65	1.95	3.70	3.00	1.95	1.65	2.40	3.05	3.15	1.70
	S.D.	0.67	0.83	1.05	1.04	0.89	0.73	0.73	1.00	0.88	0.99	0.69	0.81	0.92
	S.E.	0.15	0.18	0.23	0.23	0.20	0.16	0.16	0.22	0.20	0.22	0.15	0.18	0.21
	MAX	5	5	4	5	4	5	4	4	4	5	4	5	4
	MIN	2	2	1	1	1	2	2	1	1	1	2	2	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
18	MEAN	4.00	2.90	2.60	2.70	2.60	4.30	3.40	2.40	1.40	2.90	3.60	3.80	1.40
	S.D.	0.67	0.74	1.07	0.67	0.70	0.48	0.70	0.84	0.70	0.88	0.52	0.63	0.52
	S.E.	0.21	0.23	0.34	0.21	0.22	0.15	0.22	0.27	0.22	0.28	0.16	0.20	0.16
	MAX	5	4	5	4	4	5	4	3	3	4	4	5	2
	MIN	3	2	1	2	2	4	2	1	1	2	3	3	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
19	MEAN	3.70	2.50	2.10	2.80	2.60	3.60	3.50	2.60	2.60	2.70	3.40	3.80	2.40
	S.D.	0.67	0.71	1.10	0.92	0.84	0.97	0.71	1.07	0.97	0.82	1.07	0.63	0.97
	S.E.	0.21	0.22	0.35	0.29	0.27	0.31	0.22	0.34	0.31	0.26	0.34	0.20	0.31
	MAX	5	3	4	4	4	5	4	4	4	4	4	5	4
	MIN	3	1	1	1	1	2	2	1	1	1	1	3	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
20	MEAN	4.47	3.50	2.77	3.37	3.50	4.30	4.00	2.67	2.23	3.43	4.13	4.17	2.50
	S.D.	0.63	0.73	0.94	0.76	0.63	0.75	0.59	0.96	1.01	0.86	0.90	0.65	0.90
	S.E.	0.11	0.13	0.17	0.14	0.11	0.14	0.11	0.18	0.18	0.16	0.16	0.12	0.16
	MAX	5	4	5	4	4	5	5	4	4	5	5	5	4
	MIN	3	1	1	1	2	2	2	1	1	1	1	3	1

TABLE 2-5 con't.

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
21	MEAN	3.80	2.90	2.90	2.50	2.40	3.20	3.40	2.90	1.40	2.60	3.40	3.20	2.40
	S.D.	0.63	0.74	0.57	0.71	0.84	0.79	0.84	0.74	0.52	0.70	0.52	0.63	0.52
	S.E.	0.20	0.23	0.18	0.22	0.27	0.25	0.27	0.23	0.16	0.22	0.16	0.20	0.16
	MAX	5	4	4	4	4	4	5	4	2	4	4	4	3
	MIN	3	2	2	2	1	2	2	2	1	2	3	2	2

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
22	MEAN	4.20	3.00	2.80	3.90	3.80	4.10	4.20	3.30	2.80	4.40	4.30	4.20	3.20
	S.D.	0.92	1.05	1.32	0.88	1.03	0.99	0.79	1.16	0.63	0.70	0.82	0.92	1.03
	S.E.	0.29	0.33	0.42	0.28	0.33	0.31	0.25	0.37	0.20	0.22	0.26	0.29	0.33
	MAX	5	4	4	5	5	5	5	5	4	5	5	5	4
	MIN	2	1	1	2	2	2	3	1	2	3	3	2	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
23	MEAN	4.10	3.60	3.20	3.20	3.50	3.80	4.40	1.70	1.70	4.30	4.80	4.20	2.50
	S.D.	0.88	0.70	0.63	1.03	0.97	0.79	0.70	0.82	0.67	0.48	0.42	0.63	0.85
	S.E.	0.28	0.22	0.20	0.33	0.31	0.25	0.22	0.26	0.21	0.15	0.13	0.20	0.27
	MAX	5	4	4	4	5	5	5	3	3	5	5	5	4
	MIN	2	2	2	1	2	2	3	1	1	4	4	3	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
24	MEAN	4.40	4.00	3.70	3.90	3.70	4.30	4.40	3.60	3.30	4.50	4.30	3.60	3.70
	S.D.	0.84	0.94	0.67	1.10	1.06	1.25	0.84	1.07	1.06	0.71	1.25	0.97	0.95
	S.E.	0.27	0.30	0.21	0.35	0.33	0.40	0.27	0.34	0.33	0.22	0.40	0.31	0.30
	MAX	5	5	4	5	5	5	5	5	5	5	5	5	5
	MIN	3	2	2	2	2	2	3	2	2	3	1	2	2

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
25	MEAN	4.30	3.50	3.20	3.60	3.90	4.40	3.80	3.30	3.20	4.20	4.30	4.40	3.80
	S.D.	0.48	0.53	0.79	0.70	0.57	0.70	0.79	0.82	0.79	0.42	0.67	0.52	0.63
	S.E.	0.15	0.17	0.25	0.22	0.18	0.22	0.25	0.26	0.25	0.13	0.21	0.16	0.20
	MAX	5	4	4	5	5	5	5	4	4	5	5	5	5
	MIN	4	3	2	3	3	3	3	2	2	4	3	4	3

TABLE 2-5 con't.

HRC		n	o	p	q	r	s	t	u	v	w	x	y
1	MEAN	4.60	4.90	4.70	5.00	5.00	5.00	5.00	4.90	4.70	5.00	4.90	5.00
	S.D.	1.26	0.32	0.48	0.00	0.00	0.00	0.00	0.32	0.48	0.00	0.32	0.00
	S.E.	0.40	0.10	0.15	0.00	0.00	0.00	0.00	0.10	0.15	0.00	0.10	0.00
	MAX	5	5	5	5	5	5	5	5	5	5	5	5
	MIN	1	4	4	5	5	5	5	4	4	5	4	5

HRC		n	o	p	q	r	s	t	u	v	w	x	y
2	MEAN	5.00	4.60	4.60	4.90	4.50	4.10	4.00	4.40	4.30	4.40	4.60	4.60
	S.D.	0.00	0.52	0.52	0.32	0.53	0.57	0.82	0.52	0.82	0.52	0.52	0.70
	S.E.	0.00	0.16	0.16	0.10	0.17	0.18	0.26	0.16	0.26	0.16	0.16	0.22
	MAX	5	5	5	5	5	5	5	5	5	5	5	5
	MIN	5	4	4	4	4	3	3	4	3	4	4	3

HRC		n	o	p	q	r	s	t	u	v	w	x	y
3	MEAN	4.70	4.70	4.40	4.90	4.70	4.70	4.90	4.70	4.60	4.70	4.70	4.50
	S.D.	0.67	0.67	0.84	0.32	0.48	0.48	0.32	0.67	0.52	0.48	0.67	0.53
	S.E.	0.21	0.21	0.27	0.10	0.15	0.15	0.10	0.21	0.16	0.15	0.21	0.17
	MAX	5	5	5	5	5	5	5	5	5	5	5	5
	MIN	3	3	3	4	4	4	4	3	4	4	3	4

HRC		n	o	p	q	r	s	t	u	v	w	x	y
4	MEAN	1.65	2.55	2.40	1.70	1.55	1.60	1.75	2.90	2.30	2.75	2.65	1.60
	S.D.	0.67	0.69	0.88	0.66	0.76	1.05	0.85	0.97	0.98	0.79	0.88	0.88
	S.E.	0.15	0.15	0.20	0.15	0.17	0.23	0.19	0.22	0.22	0.18	0.20	0.20
	MAX	3	4	4	3	3	5	4	4	4	4	4	4
	MIN	1	1	1	1	1	1	1	1	1	1	1	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
5	MEAN	2.60	3.20	3.40	2.20	3.20	1.20	2.50	3.90	3.30	3.40	3.10	3.00
	S.D.	0.70	0.63	0.84	0.79	0.79	0.42	0.71	0.57	0.67	0.84	0.74	0.82
	S.E.	0.22	0.20	0.27	0.25	0.25	0.13	0.22	0.18	0.21	0.27	0.23	0.26
	MAX	4	4	4	3	5	2	3	5	4	5	4	4
	MIN	2	2	2	1	2	1	1	3	2	2	2	2

TABLE 2-5 con't.

HRC		n	o	p	q	r	s	t	u	v	w	x	y
6	MEAN	1.70	2.30	2.90	1.20	2.10	1.20	2.00	3.80	2.00	2.70	2.90	2.20
	S.D.	0.67	0.95	0.88	0.42	0.32	0.42	0.94	0.42	0.82	0.82	0.99	1.03
	S.E.	0.21	0.30	0.28	0.13	0.10	0.13	0.30	0.13	0.26	0.26	0.31	0.33
	MAX	3	4	4	2	3	2	4	4	3	4	5	4
	MIN	1	1	2	1	2	1	1	3	1	2	2	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
7	MEAN	2.70	3.40	3.50	2.90	3.10	2.30	2.67	3.60	2.80	3.20	3.50	2.90
	S.D.	1.16	0.97	0.71	1.10	1.10	0.95	1.12	0.70	1.03	0.92	0.71	0.99
	S.E.	0.37	0.31	0.22	0.35	0.35	0.30	0.37	0.22	0.33	0.29	0.22	0.31
	MAX	5	5	4	4	4	4	4	4	4	4	4	4
	MIN	1	2	2	1	1	1	1	2	1	1	2	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
8	MEAN	3.00	3.40	3.70	2.90	3.50	2.40	2.80	3.70	3.00	3.50	3.90	3.40
	S.D.	1.15	0.97	0.48	0.99	0.97	0.97	0.79	0.82	1.15	0.85	0.88	1.17
	S.E.	0.37	0.31	0.15	0.31	0.31	0.31	0.25	0.26	0.37	0.27	0.28	0.37
	MAX	4	5	4	4	5	4	4	5	4	4	5	5
	MIN	1	2	3	1	2	1	1	2	1	2	2	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
9	MEAN	2.90	3.00	3.10	2.30	3.20	2.40	2.80	4.00	3.00	3.10	3.90	3.70
	S.D.	1.10	0.67	0.74	0.95	0.79	1.35	0.79	0.94	1.05	0.88	0.57	0.82
	S.E.	0.35	0.21	0.23	0.30	0.25	0.43	0.25	0.30	0.33	0.28	0.18	0.26
	MAX	4	4	4	4	4	5	4	5	5	4	5	5
	MIN	1	2	2	1	2	1	2	2	2	2	3	3

HRC		n	o	p	q	r	s	t	u	v	w	x	y
10	MEAN	3.70	3.67	3.90	3.50	4.20	2.70	3.10	4.90	4.30	4.10	4.00	4.20
	S.D.	0.67	0.50	0.74	0.71	0.63	0.95	0.74	0.32	0.67	0.32	0.47	0.63
	S.E.	0.21	0.17	0.23	0.22	0.20	0.30	0.23	0.10	0.21	0.10	0.15	0.20
	MAX	5	4	5	5	5	4	4	5	5	5	5	5
	MIN	3	3	3	3	3	1	2	4	3	4	3	3

TABLE 2-5 con't.

HRC		n	o	p	q	r	s	t	u	v	w	x	y
11	MEAN	1.80	1.90	1.70	1.40	1.60	1.10	1.50	2.70	1.70	2.00	1.60	1.80
	S.D.	0.79	0.88	0.48	0.52	0.84	0.32	0.97	0.82	0.82	0.67	0.97	1.23
	S.E.	0.25	0.28	0.15	0.16	0.27	0.10	0.31	0.26	0.26	0.21	0.31	0.39
	MAX	3	3	2	2	3	2	4	4	3	3	4	4
	MIN	1	1	1	1	1	1	1	2	1	1	1	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
12	MEAN	1.50	1.70	2.40	1.70	1.40	1.50	1.20	2.20	1.20	2.00	2.40	1.10
	S.D.	0.71	0.67	0.84	0.95	0.97	1.27	0.63	0.92	0.63	0.82	0.84	0.32
	S.E.	0.22	0.21	0.27	0.30	0.31	0.40	0.20	0.29	0.20	0.26	0.27	0.10
	MAX	3	3	4	3	4	5	3	4	3	4	4	2
	MIN	1	1	1	1	1	1	1	1	1	1	1	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
13	MEAN	2.10	2.10	2.10	1.30	1.50	1.40	1.60	1.90	1.30	2.00	2.10	2.10
	S.D.	0.88	1.10	0.88	0.48	0.71	0.70	0.52	0.88	0.48	1.05	0.74	0.74
	S.E.	0.28	0.35	0.28	0.15	0.22	0.22	0.16	0.28	0.15	0.33	0.23	0.23
	MAX	3	4	3	2	3	3	2	3	2	4	3	3
	MIN	1	1	1	1	1	1	1	1	1	1	1	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
14	MEAN	2.70	2.30	2.30	1.60	2.80	1.10	2.20	1.80	1.80	2.70	2.10	2.60
	S.D.	0.48	0.67	0.67	1.07	0.79	0.32	1.23	1.03	0.79	0.82	0.99	0.84
	S.E.	0.15	0.21	0.21	0.34	0.25	0.10	0.39	0.33	0.25	0.26	0.31	0.27
	MAX	3	3	3	4	4	2	5	4	3	4	4	4
	MIN	2	1	1	1	2	1	1	1	1	2	1	2

HRC		n	o	p	q	r	s	t	u	v	w	x	y
15	MEAN	1.55	1.90	2.00	1.40	1.35	1.40	1.75	2.55	1.50	2.15	1.55	1.85
	S.D.	0.76	0.97	0.65	0.60	0.49	0.60	0.85	0.69	0.76	0.88	0.69	0.93
	S.E.	0.17	0.22	0.15	0.13	0.11	0.13	0.19	0.15	0.17	0.20	0.15	0.21
	MAX	3	4	3	3	2	3	3	4	3	4	3	4
	MIN	1	1	1	1	1	1	1	1	1	1	1	1

TABLE 2-5 con't.

HRC		n	o	p	q	r	s	t	u	v	w	x	y
16	MEAN	1.50	1.30	2.40	1.30	1.60	1.30	2.00	3.00	1.90	2.70	2.00	1.50
	S.D.	0.97	0.48	0.70	0.67	0.70	0.48	1.25	0.94	0.88	0.67	0.94	0.97
	S.E.	0.31	0.15	0.22	0.21	0.22	0.15	0.39	0.30	0.28	0.21	0.30	0.31
	MAX	4	2	4	3	3	2	4	5	4	4	4	4
	MIN	1	1	2	1	1	1	1	2	1	2	1	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
17	MEAN	1.50	1.55	2.90	1.45	1.60	1.85	2.30	2.90	1.90	2.85	2.75	1.60
	S.D.	0.61	0.69	0.91	0.89	0.60	0.99	1.13	0.72	0.91	0.67	1.02	0.75
	S.E.	0.14	0.15	0.20	0.20	0.13	0.22	0.25	0.16	0.20	0.15	0.23	0.17
	MAX	3	3	4	4	3	5	5	4	4	4	5	4
	MIN	1	1	1	1	1	1	1	2	1	2	1	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
18	MEAN	1.70	1.90	2.60	1.70	1.90	1.40	1.80	3.30	1.30	2.90	3.10	1.70
	S.D.	0.67	0.57	0.84	0.82	0.74	0.70	0.63	0.67	0.67	0.74	0.57	0.82
	S.E.	0.21	0.18	0.27	0.26	0.23	0.22	0.20	0.21	0.21	0.23	0.18	0.26
	MAX	3	3	4	3	3	3	3	4	3	4	4	3
	MIN	1	1	1	1	1	1	1	2	1	2	2	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
19	MEAN	2.60	2.50	3.10	1.90	2.00	1.80	2.10	3.70	2.20	2.60	3.20	3.00
	S.D.	1.07	0.97	0.74	0.88	0.82	0.63	0.74	1.06	0.79	0.70	0.92	0.94
	S.E.	0.34	0.31	0.23	0.28	0.26	0.20	0.23	0.33	0.25	0.22	0.29	0.30
	MAX	4	4	4	3	3	3	3	5	3	4	4	4
	MIN	1	1	2	1	1	1	1	1	1	2	1	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
20	MEAN	2.27	3.07	3.63	2.47	3.13	2.40	3.03	4.03	3.00	3.63	3.60	3.13
	S.D.	0.87	0.87	0.81	0.97	0.82	0.89	0.89	0.76	0.79	0.67	0.86	1.01
	S.E.	0.16	0.16	0.15	0.18	0.15	0.16	0.16	0.14	0.14	0.12	0.16	0.18
	MAX	4	5	5	4	4	4	4	5	4	5	5	5
	MIN	1	1	1	1	1	1	1	2	1	2	1	1

TABLE 2-5 con't.

HRC		n	o	p	q	r	s	t	u	v	w	x	y
21	MEAN	2.50	2.00	3.10	1.90	2.30	2.20	2.90	3.50	2.40	3.30	3.10	2.50
	S.D.	0.71	0.82	0.74	0.57	0.82	1.14	0.32	0.53	0.84	0.67	0.74	0.85
	S.E.	0.22	0.26	0.23	0.18	0.26	0.36	0.10	0.17	0.27	0.21	0.23	0.27
	MAX	4	3	4	3	3	4	3	4	4	4	4	4
	MIN	2	1	2	1	1	1	2	3	1	2	2	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
22	MEAN	2.80	3.50	4.10	3.30	3.80	2.00	2.90	4.20	4.00	3.70	3.50	4.00
	S.D.	0.79	0.97	0.88	0.67	0.63	0.82	0.74	0.92	0.82	1.06	0.85	1.25
	S.E.	0.25	0.31	0.28	0.21	0.20	0.26	0.23	0.29	0.26	0.33	0.27	0.39
	MAX	4	5	5	4	4	3	4	5	5	5	4	5
	MIN	1	2	3	2	2	1	2	2	2	1	2	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
23	MEAN	2.10	3.70	3.80	3.40	4.20	2.70	3.50	3.90	3.50	3.90	3.60	2.60
	S.D.	0.88	0.48	1.03	0.70	0.92	1.16	0.71	0.57	0.53	1.10	0.70	0.97
	S.E.	0.28	0.15	0.33	0.22	0.29	0.37	0.22	0.18	0.17	0.35	0.22	0.31
	MAX	4	4	5	4	5	4	4	5	4	5	4	4
	MIN	1	3	2	2	2	1	2	3	3	1	2	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
24	MEAN	3.60	3.56	4.00	2.90	3.40	3.10	3.90	4.40	3.90	3.90	3.60	3.20
	S.D.	0.97	1.13	1.25	0.99	0.84	0.99	0.57	0.97	1.10	0.88	0.84	1.14
	S.E.	0.31	0.38	0.39	0.31	0.27	0.31	0.18	0.31	0.35	0.28	0.27	0.36
	MAX	5	5	5	4	4	4	5	5	5	5	4	5
	MIN	2	2	2	1	2	1	3	2	2	2	2	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
25	MEAN	3.70	3.20	3.80	3.40	3.90	2.50	3.30	4.30	4.00	3.80	4.20	4.40
	S.D.	0.48	0.79	0.92	0.52	0.57	0.85	0.67	0.48	0.67	0.42	0.63	0.70
	S.E.	0.15	0.25	0.29	0.16	0.18	0.27	0.21	0.15	0.21	0.13	0.20	0.22
	MAX	4	4	5	4	5	4	4	5	5	4	5	5
	MIN	3	2	2	3	3	1	2	4	3	3	3	3

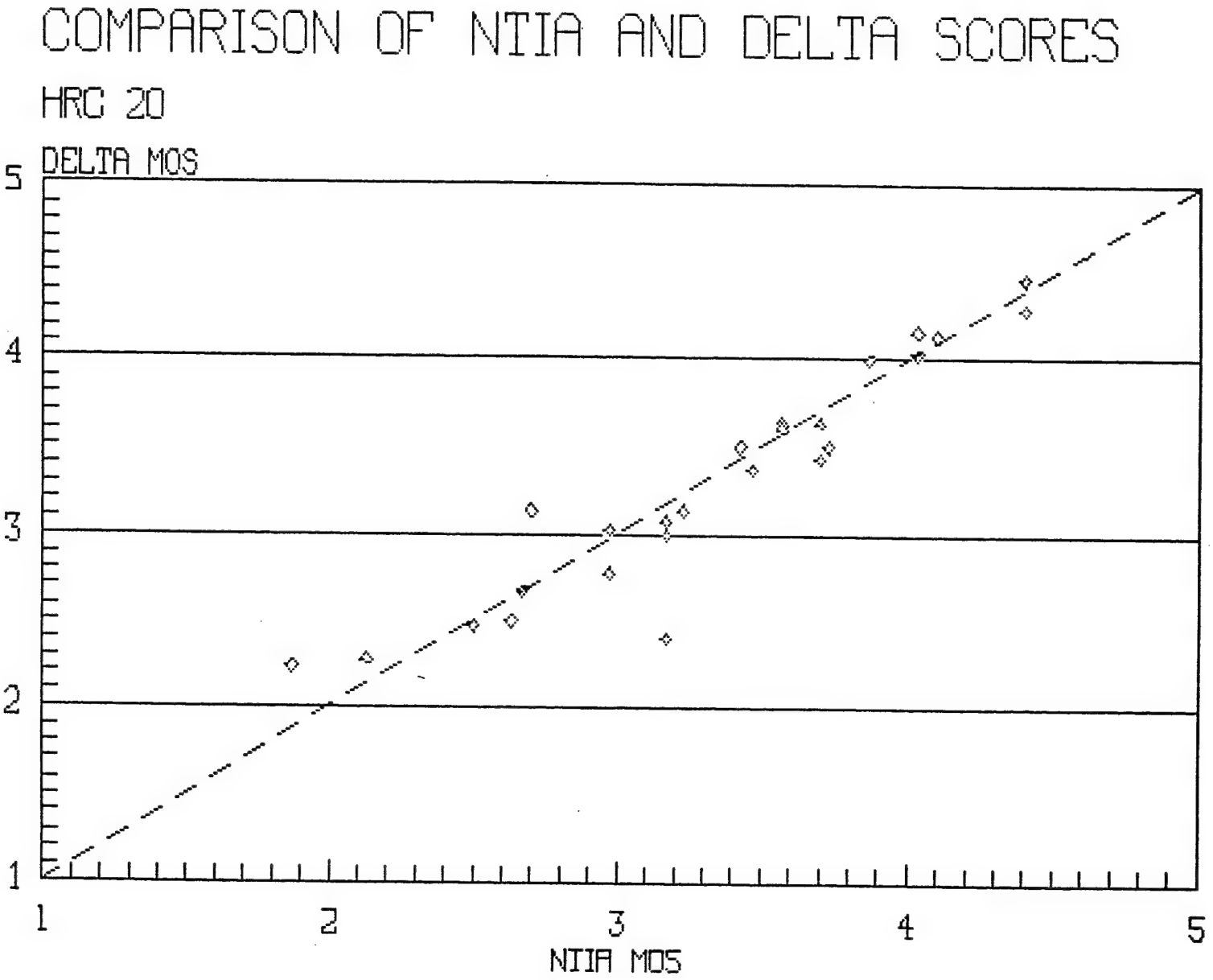
COMPARISON OF NTIA AND DELTA SCORES
HRC 20
DELTA MOS
5
4
3
2
1
1
2
3
4
5
NTIA MOS

FIGURE 2.2

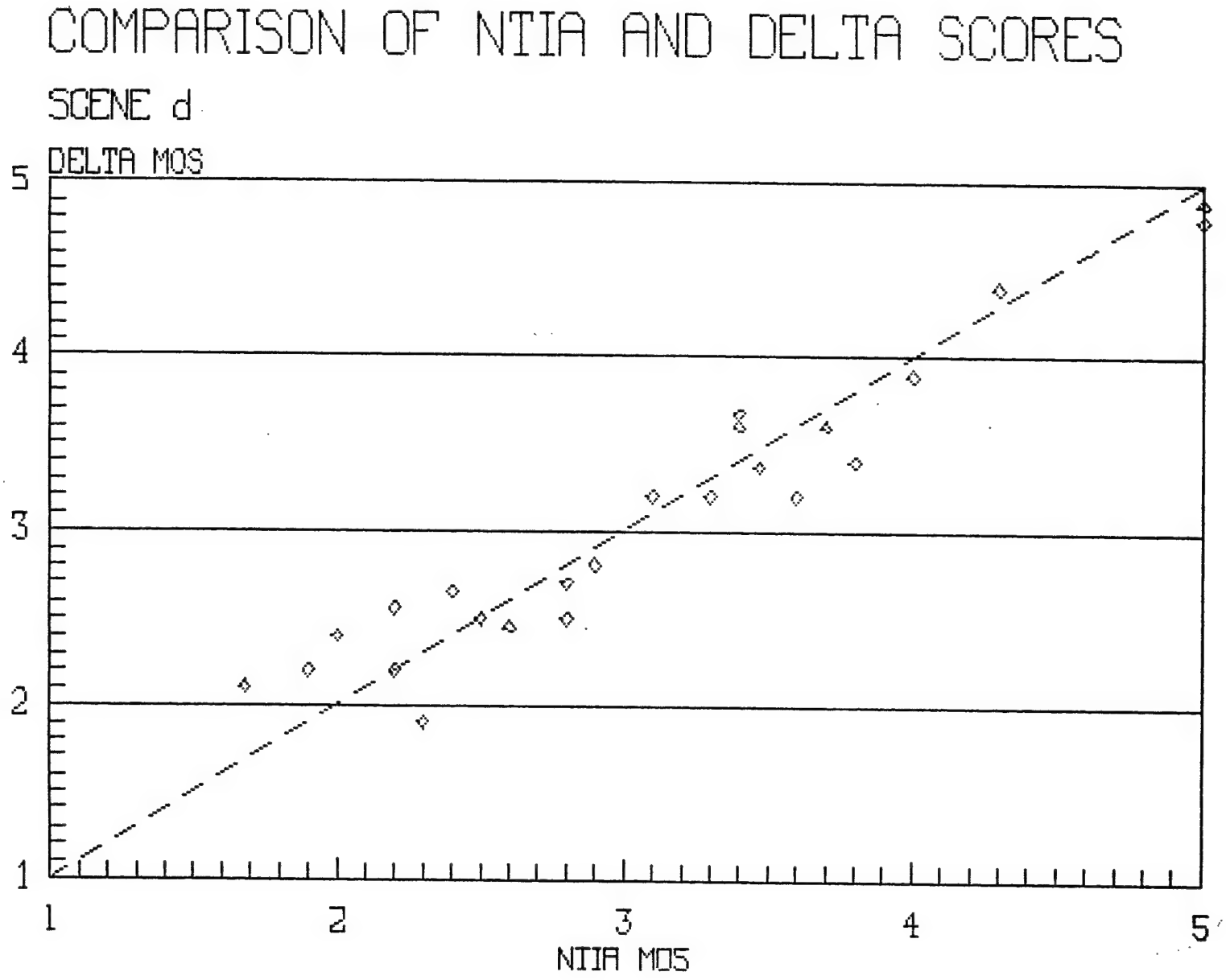
COMPARISON OF NTIA AND DELTA SCORES
SCENE d
DELTA MOS
5
4
3
2
1
1
2
3
4
5
NIIA MOS

FIGURE 2.3

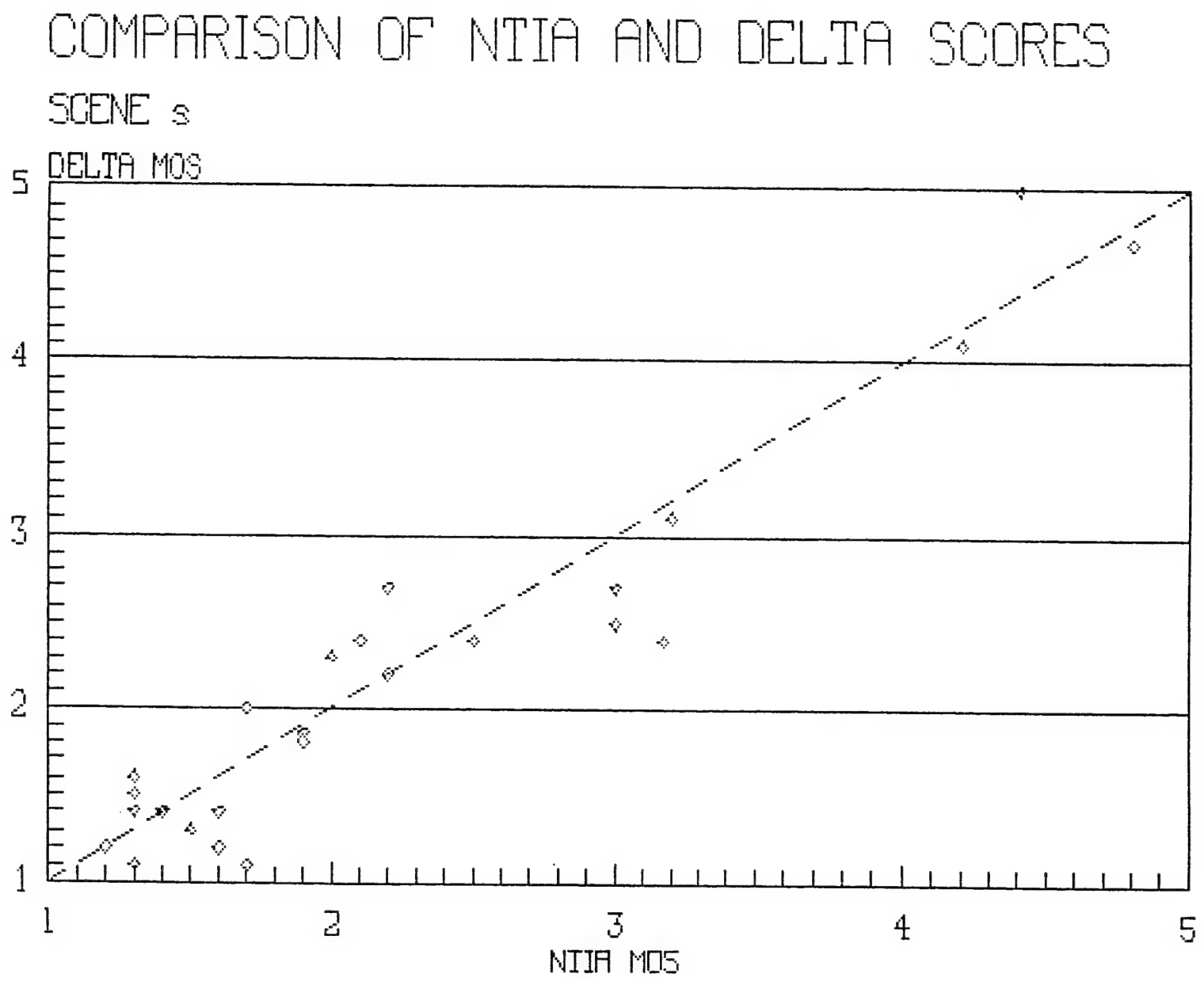
COMPARISON OF NTIA AND DELTA SCORES
SCENE s
DELTA MOS
5
4
3
2
1
1
2
3
4
5
NTIA MOS

FIGURE 2.4

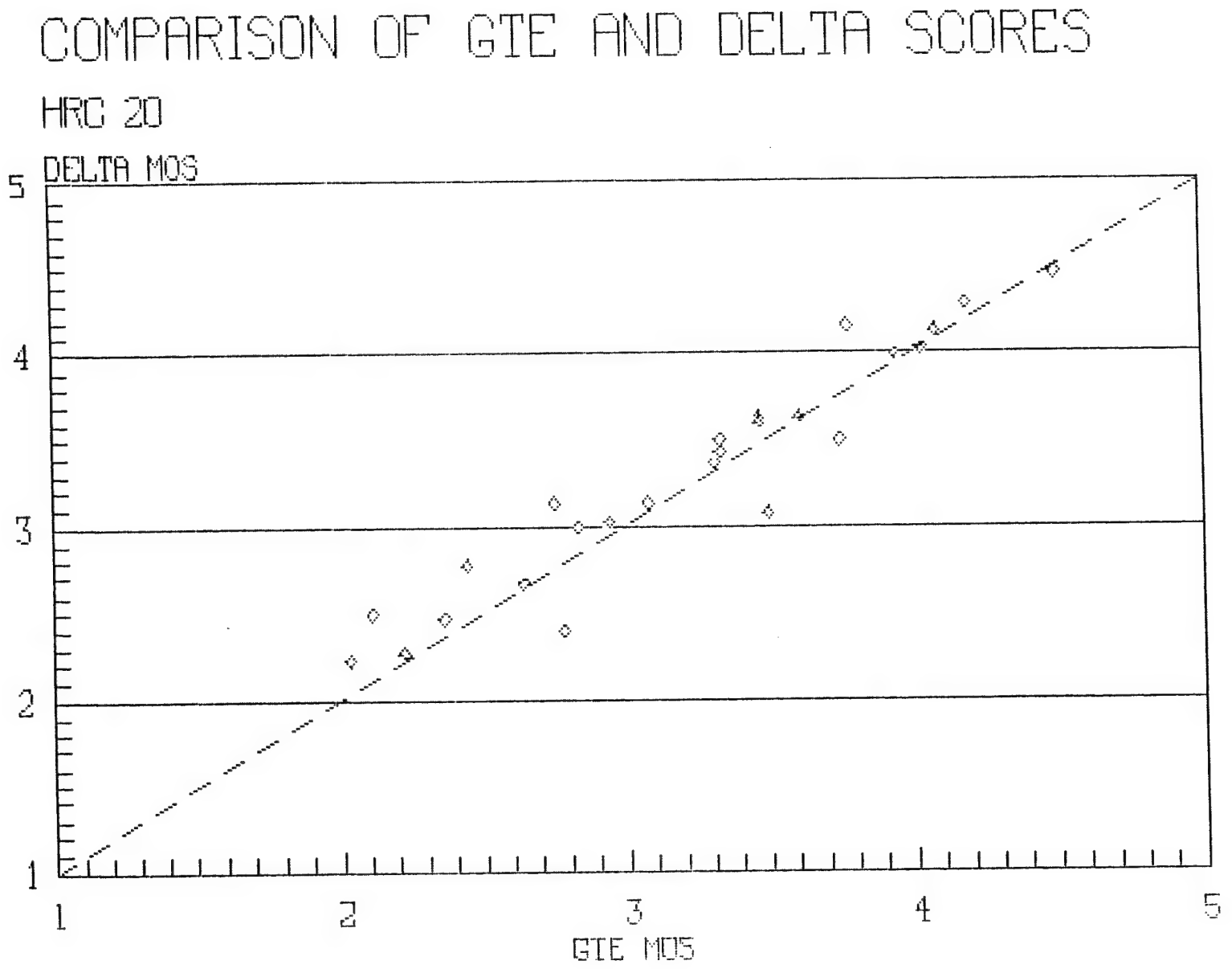
COMPARISON OF GTE AND DELTA SCORES
HRC 20
DELTA MOS
5
4
3
2
1
1
2
3
4
5
GTE MOS

FIGURE 2.5

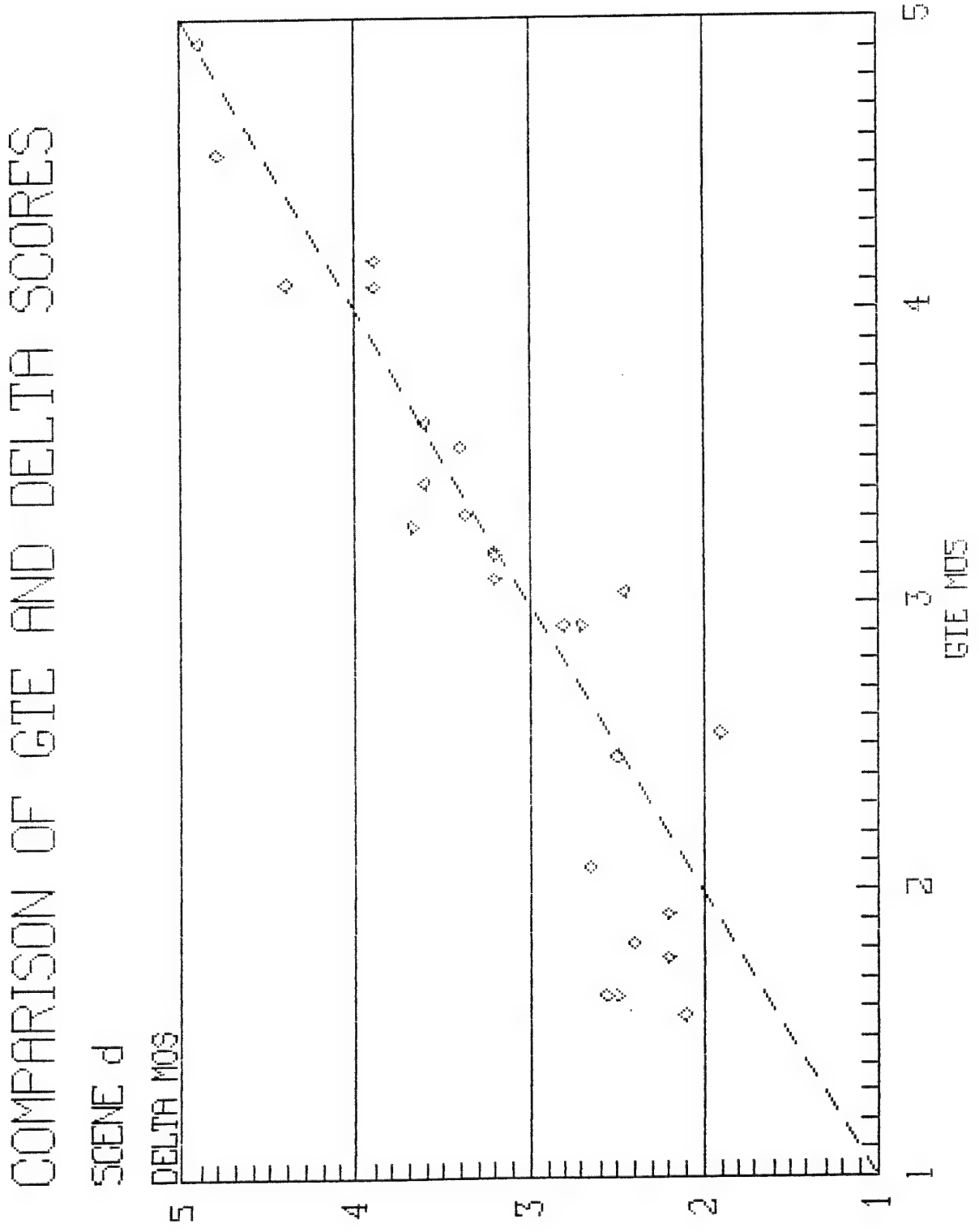
COMPARISON OF GTE AND DELTA SCORES
SCENE d
DELTA MOS
GTE MOS
5
4
3
2
1
1
2
3
4
5

FIGURE 2.6

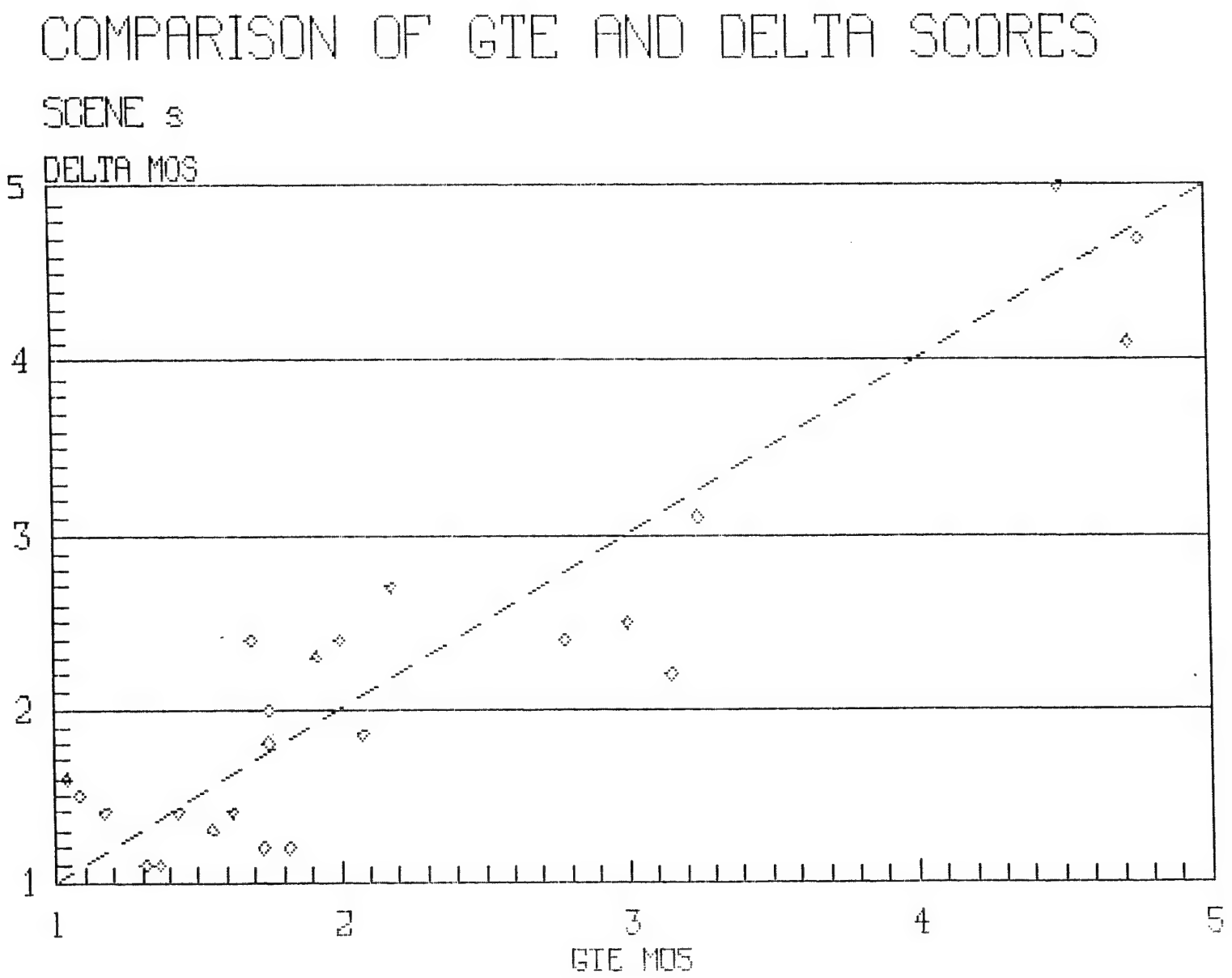
COMPARISON OF GTE AND DELTA SCORES
SCENE 5
DELTA MOS
5
4
3
2
1
1
2
3
4
5
GTE MOS

FIGURE 2.7

3.0 OBJECTIVE TESTING

3.1 Executive Summary

The Objective Testing reported herein is required by T1A1.5 to support development of transmission standards for Video Telephony and for Video Teleconferencing.

Results of the Objective Tests have resulted in Fair to Poor correlation with the Subjective Testing.

3.2 Test Location

All objective tests done by Delta Information Systems were performed in the Engineering Laboratory in their facility at 300 Welsh Road, Horsham, Pennsylvania.

3.3 Test Performed

Delta has designed a series of computer-generated test patterns for objective motion tests. They make it possible to define and numerically measure certain motion parameters. The two types of test patterns are the rotating wheel and switched dots. The rotating wheel patterns feature three different spoke widths, which combined with six to nine rotation speeds, produce 23 patterns. These patterns are included in the betacam tapes along with the 25 scenes processed by 25 HRCs and are analyzed by measurement of temporal response and transmitted frame rate. The switched dot patterns feature three different white dots alternating with a black background. Analysis of the dot pattern is by observing the frames required for full amplitude response following a pattern switch (scene cut response {SCR}).

It was decided that the emphasis for this year would be placed on SCR measurements.

3.3.1 Test Procedure

a. Using the large dot pattern, freeze the first frame following the scene cut.

b. Select a line near the top of the scene which passes through the center of a selected white dot. Record the dot amplitude.

c. Repeat this measurement on at least two other lines near the center and at the bottom of the scene. Average the results.

d. Advance the tape frame, and record all changes in amplitude until the dot white amplitude approximates 100%.

e. The number of frames required to achieve full brightness is a measure of the image update time.

f. Repeat for medium and small dot patterns.

3.4 Test Result

The SCR for several HRCs are shown in Table 3-1. The measurement made is of the number of frames required for the peak white of the dot pattern to achieve the steady-state level. These measurements were made for the large, medium, and small dot patterns. It is noted that some HRCs are quicker for the small dots while some respond more slowly for small dots. It is also noted that several HRCs show no measurable delay for all three dot patterns. The analysis of these results have concluded that the test conducted on the recorded dot patterns needs a time code for monitoring signal transient response measurements.

TABLE 3-1 - SUMMARY OF TEST RESULTS

NO.	HRC			SCENE CUT RESPONSE (Number of TV Frames)		
	ALGORITHM	DATA RATE	CODER/ DECODER	LARGE DOTS	MEDIUM DOTS	SMALL DOTS
4	PROPRIETARY VECT. QUANTI-ZATION	128	-	9	12	21
5		384	-	3	4	7
6	PROPRIETARY TYPE C	128	_	3	2	1
7		384	-	2	1	2
8		768	-	1	1	1
9	PROPRIETARY TYPE D	768	-	2	4	7
10		1536	-	2	3	4
11	H.261-QCIF	128	DIFF	2	2	2
12	H.261-QCIF	128	SAME	2	1	1
13	H.261-QCIF	168	SAME	0	0	0
14	H.261-QCIF	384	DIFF	2	2	2
15	H.261-CIF	128	SAME	0	0	0
16	H.261-CIF	128	SAME	0	0	0
17	H.261-CIF	128	DIFF	0	0	0
19	H.261-CIF	256	SAME	0	0	0

4.0 COMPARISON OF SUBJECTIVE AND OBJECTIVE TESTS

The results of both the subjective and objective tests are shown in Table 4-1. Shown in this Table are the Mean Subjective Score for three groupings, as follows:

a. Overall - All scenes except h, i, and y;
b. VT (Video Telephony) - scenes f, j, k, and l;
c. VTC (Video Teleconferencing) - scenes d, g, o, p, q, and r.

A review of the results of subjective and objective measurements show significant inconsistency. Why would the SCR measure so good (quick response) when the subjective performance is poor? The answer appears to be that video encoders employ widely different coding strategies when a sudden scene change occurs, such as a scene cut. One manufacturer may feel that the user prefers to see the scene built up dynamically from the original image to the new image. HRC 4 is an example of such a case where the bit rate is low (128 kb/s), the quality is low (2.35), and the SCR is correspondingly poor (21 frames for small dots). Contrarily, other vendors (see HRC 11 to 19) may feel that the user would be distracted by the dynamically changing, distorted transitional images and would prefer to take a long time to transmit the first new frame with very high quality. In such a case, the response to the scene cut takes the form of a delayed, accurate reproduction rather than a slow buildup of many distorted frames. In both cases, the input scene cut is distorted; it is merely a matter of the type of distortion which different vendors consider least disturbing to the eye.

It is possible to develop a more rigorous test procedure for measuring the delay in the scene cut response in the case of HRCs 11 to 19, or the transition time in the case of HRCs 4, 5, 9, and 10. Unfortunately, the video tapes containing the video test patterns used for SCR did not have time coding.

TABLE 4-1 - SUMMARY OF TEST RESULTS

NO.	HRC			MEAN SUBJ. SCORE			SCENE CUT RESPONSE (Number of TV Frames)		
	ALGORITHM	DATA RATE	CODER/ DECODER	OVERALL	VT	VTC	LARGE DOTS	MEDIUM DOTS	SMALL DOTS
4	PROPRIETARY VECT. QUANTI-ZATION	128	-	2.35	3.26	2.25	9	12	21
5		384	-	3.21	3.98	3.07	3	4	7
6	PROPRIETARY TYPE C	128	-	2.62	3.58	2.33	3	2	1
7		384	-	3.18	3.65	3.22	2	1	2
8		768	-	3.47	4.00	3.48	1	1	1
9	PROPRIETARY TYPE D	768	-	3.39	4.18	3.17	2	4	7
10		1536	-	4.22	4.73	3.89	2	3	4
11	H.261-QCIF	128	DIFF	2.00	2.40	1.83	2	2	2
12	H.261-QCIF	128	SAME	1.95	2.60	1.93	2	1	1
13	H.261-QCIF	168	SAME	1.97	2.65	1.90	0	0	0
14	H.261-QCIF	384	DIFF	2.37	3.10	2.22	2	2	2
15	H.261-CIF	128	SAME	2.00	2.63	1.81	0	0	0
16	H.261-CIF	128	SAME	2.23	2.75	1.93	0	0	0
17	H.261-CIF	128	DIFF	2.47	3.08	2.19	0	0	0
19	H.261-CIF	256	SAME	2.75	3.38	2.63	0	0	0

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The rather poor correlation of the Objective SCR with Subjective scoring of video scenes is attributed to changes in the encoding strategies on the assumption that users may prefer not to see the picture dynamically change when the input scene changes radically. Consequently, the SCR may need to yield to another objective test method for predicting the subjective performance of a video system.

5.2 Recommendations

Although the results of the SCR were disappointing, a great deal has been learned about the problem of predicting system performance. It is very possible that the experience gained can be used to identify new objective test procedures which show promise of success.

Two examples of work which might be done are listed below.

Rotating Wheel Tests - When the Work Plan for 1994 was prepared, work was focused on the SCR rather than the Rotating Wheel (RW) objective test since recent tests had indicated more promise for the SCR and there was limited resources to investigate both. Although some of the recent tests on the RW were not highly successful, it was not concluded that the RW could not succeed to provide a useful objective test. Therefore, it is proposed to re-examine the rotating wheel test pattern, with the benefit of the SCR experience, to determine whether there is an effective way to use it for an objective test. If successful, this approach has the advantage that the RW approach can be tested for validity using existing T1A1.5 video tapes.

Scene Cut Response Tests - It may be possible to develop an SCR test which is sufficiently robust that it would be able to yield a single universal measure of distortion to an input scene cut regardless whether the codec created a transition or delay distortion.

APPENDIX A

SAMPLE IMAGES OF TEST SCENES

COMMITTEE T1
CONTRIBUTION

Document Number: T1A1.5/94-122

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STANDARDS PROJECT: Analog Interface Performance Specifications for Digital Video Teleconferencing/Video Telephony Service

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TITLE: Sample Images of Test Scenes

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ISSUE ADDRESSED: Video Quality Testing

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SOURCE: National Telecommunications and Information Administration
Institute for Telecommunication Sciences
(Arthur Webster)

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DATE: 28 March 1994

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DISTRIBUTION TO: T1A1.5

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KEYWORDS: Video Quality, Video Performance Specifications, Objective Quality, Subjective Quality, Video Test Scenes

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SAMPLE IMAGES OF TEST SCENES

1. INTRODUCTION

This contribution provides a single image from each of the 25 video test scenes that were used in the T1A1.5 VTC/VT subjective and objective testing. The following table gives the scene letter designation (a-y), the six-letter processing name, a short description, and the spatial information (SI) and temporal information (TI) values calculated as documented in the Appendix to the Draft standard T1A1.5/94-107.

Table 1:

Scene Letter	Scene Name	Description	SI	TI
a	vtc2mp	Woman at map, talking	82.3	4.3
b	vtc2zm	Woman at map with pointer, zoom	95.0	22.9
c	washdc	Map with hand & pencil	130.5	17.0
d	3inrow	Man talking, pan	81.7	30.8
e	boblec	Bob's lecture at chalkboard	64.8	21.9
f	vtc1nw	News Story (woman)	56.2	5.3
g	5row1	Five people in a row 1	77.3	8.5
h	flogar	Flower garden with windmill, pan	227.0	46.4
i	ftball	Football game	156.6	53.7
j	susie	Susie on telephone	58.7	24.6
k	disguy	Announcer (man)	48.8	8.8
l	disgal	Miss America	34.0	7.3
m	smity1	Salesman 1 (with box)	152.0	30.3
n	smity2	Salesman 2 (with magazine)	154.5	35.1
o	intros	Introductions, with pans	78.1	41.6
p	3twos	Three pairs of people, cuts	63.0	67.2
q	2wbord	Two people at whiteboard	68.7	66.8
r	split6	Split screen, 6 people	92.5	11.6
s	cirkit	Circuit diagram, zoom	237.7	48.0
t	rodmap	Roadmap, with pen	170.4	42.6
u	filter	Diagram on yellow pad	55.5	15.4
v	ysmite	Topographic map of Yosemite	88.7	16.0
w	vowels	Woman at whiteboard	114.3	17.8
x	inspec	Woman with viewgraph	46.8	12.8
y	fredas	Fred Astaire dancing	63.0	23.8

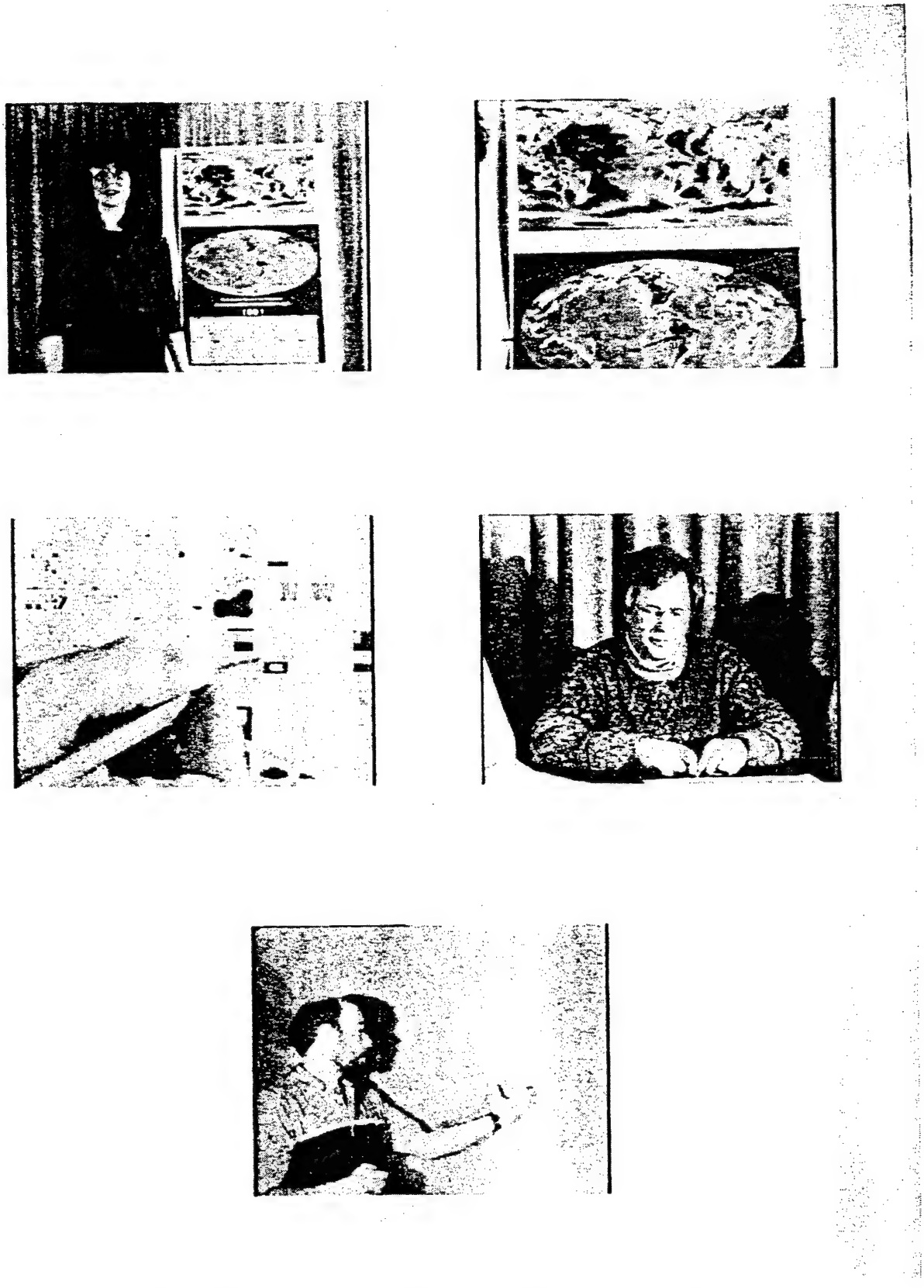

Figure 1. T1A1.5 VTC/VT Test Scenes—Sample Images

a) vtc2mp b) vtc2zm
c) washdc d) 3inrow
e) boblec

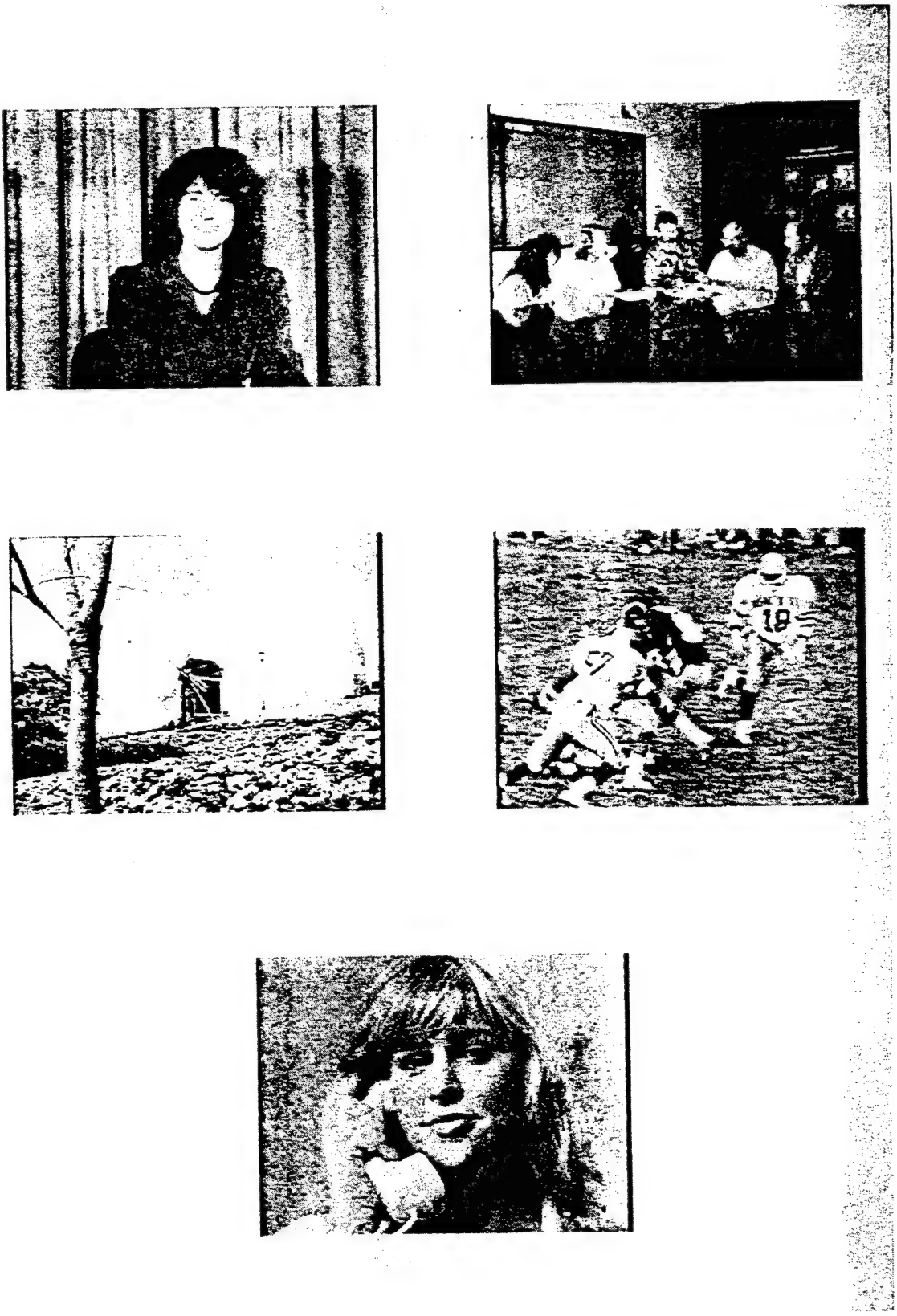

Figure 2. T1A1.5 VTC/VT Test Scenes—Sample Images

f) vtc1nw g) 5row1
h) flogar i) ftball
j) susie





Figure 3. T1A1.5 VTC/VT Test Scenes—Sample Images

k) disguy
l) disgal
m) smity1
n) smity2
o) intros

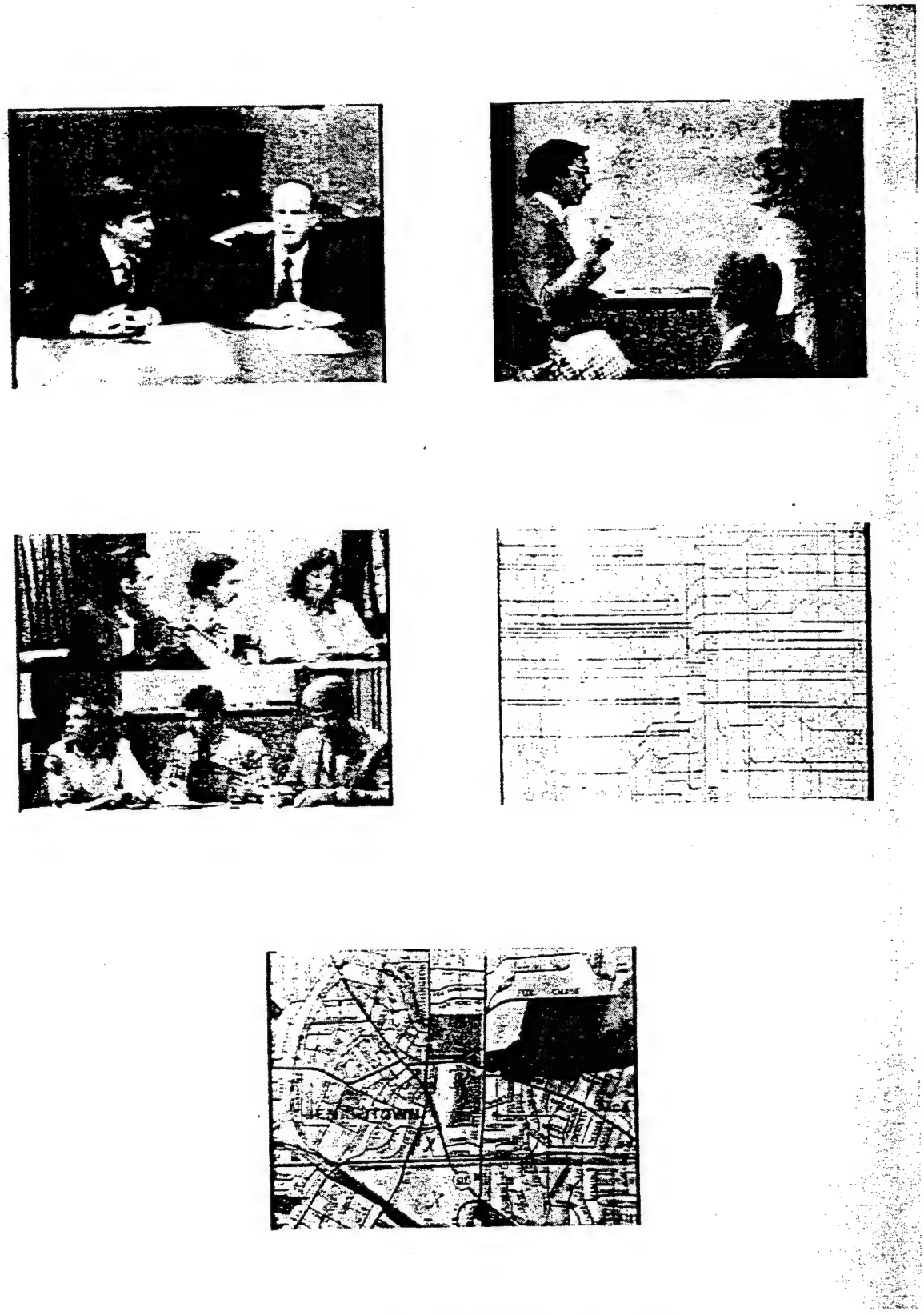

Figure 4. T1A1.5 VTC/VT Test Scenes—Sample Images

p) 3twos
q) 2wbord
r) split6
s) cirkit
t) rodmap

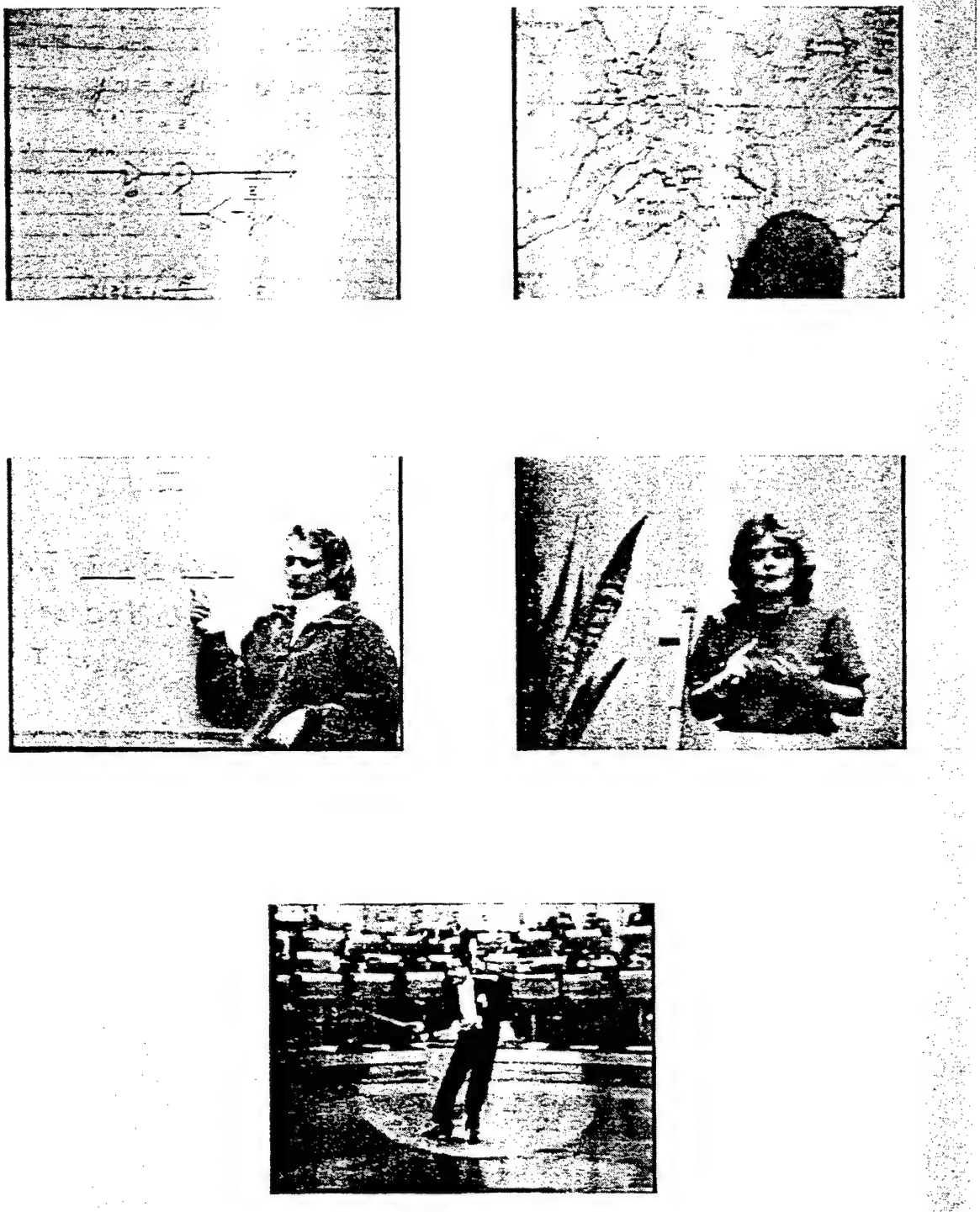

Figure 5. T1A1.5 VTC/VT Test Scenes—Sample Images

u) filter
v) ysmite
w) vowels
x) inspec
y) fredas

APPENDIX B

SUBJECTIVE TEST PLAN

CONTRIBUTION TO T1 STANDARDS PROJECT

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STANDARDS PROJECT: Analog Interface Performance Specifications for Digital Video Teleconferencing/Video Telephony Service

****

TITLE: Subjective Test Plan (Tenth and Final Draft)

****

EDITOR: A. C. Morton, AT&T Communications

SOURCE: Detailed Test Plan Ad Hoc Group and Data Analysis Ad Hoc Group

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ABSTRACT:

This is the subjective test plan required by T1A1.5 to complete its video performance specification project. The Detailed Test Plan Ad Hoc Group prepared this plan for the February 8, 1993 meeting, where version T1A1.5/93-014 R1 was originally accepted by the full Working Group.
In the process of developing the Data Analysis Plan, some of the calculations originally envisioned were deemed unnecessary. The Data Analysis Ad Hoc Group was then free to develop a more balanced sampling plan and make other improvements to the subjective test plan.
Revisions and new material from subsequent meetings of the Data Analysis Ad Hoc Group were adopted as version T1A1.5/93-014 R5 (on a technical basis) at the August 9, 1993 Working Group meeting. Some changes and additional appendices were adopted at the November 1993, January 1994, and July 1994 meetings of the Working Group.

Video Performance Standard Subjective Test Plan

1. INTRODUCTION

Working Group T1A1.5 is in the process of preparing an ANSI standard on video teleconference system performance measurement. The process includes steps to identify objective measures of video performance, to compare the objective measures with user opinion of video quality, and to select from the candidate measures those that are well-correlated with user opinion, as only these measures offer the desired information.

During the T1A1.5 meetings in October, 1992, agreement was reached on a set of 25 video test scenes and on 25 Hypothetical Reference Circuits (HRC). The test scenes, along with candidate objective test waveforms, have been assembled on D2 format video tape and played through the 25 HRC's. The 25 by 25 matrix results in 625 different test combinations, where a test combination is defined as the record of a single scene transmitted through a single HRC.

To correlate the candidate measures with a representative user's view of video quality, an estimate of the perceived quality of each test combination must be available. Working Group T1A1.5 formed an Ad Hoc Group to develop a detailed procedure for both subjective and objective testing. This document describes the subjective test procedure to be followed at each of the three test laboratories (Delta Information Systems, GTE Labs, and NTIA-ITS), in which the above test combinations become the stimuli for a video grading task.

The procedure will follow CCIR Recommendation 500-5 in general. This document identifies the specific sections and procedures to use, since there are many options within the Recommendation. Further, additional details specific to this test program will be defined here, such as the number of subjects required to view each test combination, and the division of test combinations between the three labs. In this way, the controlled conditions and test delivery will be determined and maximal consistency among the laboratories should result.

The GOAL of this Test Procedure is to estimate the distribution of opinion of video teleconference system users when presented with representative video sequences.

The following points represent the group's philosophy concerning the standard's development:

1. The intent of this process is to study the relative performance of a set of proposed objective video measures as predictors of subjective judgement.
2. The process is an evolutionary one, and the membership does not necessarily expect to reach the final set of measures in a single step, or single cycle through the process.
3. While negative contingencies or failures of the process may not be defined to the last detail, the membership believes that they have experience necessary to recognize when the results indicate failure. Further, that they are willing to

proceed with this research process with an understanding of the risks.

4. There is a need, raised here and previously by other members, to develop a document which describes the data analysis process step in some detail. This document should exist prior to the completion of the testing steps. (The completed data analysis plan appears in Section 5.)

5. It is recognized that the precision of the conclusions drawn as to the relationship between objective and subjective performance will be based on the precision of the basic subjective testing. The Working Group in this plan will assess the level of precision needed for the results to be compelling and to receive industry consensus.

In order to be useful in the standard development process, this procedure is also consistent with the Scope and Purpose of the Draft VTC Performance Standard (T1A1.5/94-107).

2. MAJOR TEST DESIGN ATTRIBUTES

This section contains the consensus position of the Ad Hoc Group on several major areas that required determination before any subjective tests could begin.

The general starting point was this list of design requirements:

1. Test a broad range of Hypothetical Reference Circuit types.
2. Use a broad range of Test Scenes.
3. Recruit an adequate number of viewers representing a well-defined target population.
4. Test as many of these combinations as feasible.
5. Adopt a partially balanced design which ensures that the quantities of interest are not confounded with unmeasurable sources of variation.
6. Use equal-probability sampling if possible.
7. Include appropriate quality checks.
8. Use CCIR Recommendation 500-5 as a guideline.
9. Use Digital Play/Record and editing to minimize generation loss.
10. Test the subjects for suitability (i.e. vision acuity).

2.1 Test Matrix

As stated earlier, agreement was reached on a set of 25 video test scenes and on 25 Hypothetical Reference Circuits (HRC). The 25 by 25 matrix results in 625 different test combinations, as shown in Table 1.

Table 1. TEST MATRIX

SCENES	HYPOTHETICAL REF. CIRCUITS							
	1	2	3	4	.	.	.	25
a	a1	a2	a3	...				a25
b	b1	b2	...					
c	c1	...						
d	...							
.								
.								
.								
y	y1	...						y25

2.2 Number of Test Subjects

The objective of these tests is to obtain an experimental Mean Opinion Score (MOS) for each test combination where the value obtained differs by no more than ± 0.2 opinion score points from the true mean value with 95% confidence. 30 test subjects are estimated as required. The sample size was determined using the following method.

First, the standard deviation, s, was estimated (for this experiment) by review of previous experimental results. Since the range of s was found to be large ($0.1 < s < 1.0$ on a five point grading task), a representative value for s was chosen. It is

$$s = 0.5$$

Using the following equation, we determined the necessary sample size to meet the 0.2 score point confidence interval requirement, e.

$$\pm e = \frac{qt(0.975,\ n) \times s}{\sqrt{n}}$$

where $qt(0.975,\ n)$ is a percentile of the Student's t distribution for double-sided confidence intervals at 95% and n is the unknown sample size.

When $n = 30$, $e = 0.186$ and the requirement is satisfied. For the test combinations where the sample standard deviation is more than 0.5, slightly larger confidence intervals will result.

Test labs must provide 30 viewer opinions for each test combination as a minimum after screening (see Section 2.6). Viewers are expected to rate all test combinations that are shown to them. The entire data set for the 30 viewers must be provided.

2.3 Target Population and Viewer Qualifications

Viewers selected for this experiment must have normal or corrected-to-normal visual acuity and color vision. These faculties will be tested prior to participation. Viewers that do not meet these requirements must not be included in the sample.

In keeping with the goal of the plan, the viewers should represent typical video telephony/teleconference (VT/VTC) system users. Ideally, they should be persons who

use these systems now, or envision using them in the next few years. The viewers should not be persons working directly on, or in support of, the design, sales, maintenance, or performance assessment of VT/VTC systems or services.

There is one additional qualification. 50% of the viewers at each lab should have some experience with video conferencing. Some allowances may be made for recruiting difficulties.

2.4 Stimuli Presentation and Voting Method

CCIR Rec. 500-5 describes several test methodologies for subjective assessment of television pictures. The grading scale used determines the user's measure of scene rendition. The ANSI standard for expressing video performance will make reference to this scale.

The Working Group agreed on the double-stimulus/impairment scale method as described in section 2 of CCIR 500-5, with some modifications. The modifications are:

1. The rating scale used by subjects will not show the numerical values 5 through 1. These values (5 = Imperceptible) will be assigned during data entry.
2. The reduction of time intervals as defined in the presentation of test material (Figure 2 of Rec. 500-5), to allow 9 seconds to view the reference scene, a 3 second gap, 9 seconds to view the impaired scene, and a 9 second voting interval.
3. A mid-gray level of 50 IRE will be used in the interval between pairs of scenes and during the voting interval.

2.5 Voting Forms

Appendix B contains a sample voting form which is the result of collaborative effort on the part of many working group members.

2.6 Quality Checks

There are four necessary quality checks:

1. Viewer reliability will be tested through repetition of one test combination in every session. Viewers will be disqualified if their grades differ by more than 2 opinion score points (of the 1 through 5 scale) for the repeated test combination in any test session. Combinations selected for repetition will come from HRC's with either 384 kbps or 768 kbps transmission speed, so as to avoid combinations whose expected average rating scores are near either end of the rating scale.
2. Viewer reliability will also be tested through the distribution of Null HRC conditions among all test labs. Each test session will contain at least 1 Null combination. Viewers will be disqualified if they grade the Null combination at 3 or less (of the 1 through 5 scale) in any test session.
3. As many as 2 missing ratings will be tolerated per viewer. If any missing rating is on a quality check combination, then the viewer will be disqualified.

4. Lab-to-lab consistency will also be tested through repetition of 75 combinations at each of the labs. See the following section.

2.7 Partially Balanced Sampling Plan

2.7.1 Allocation of HRCs and Scenes to Video Tapes

Setting aside four HRC's for special treatment, 21 HRC's were combined into a partially balanced design described here.

Considerations of viewer burden allows us to show only about one-third of the possible test combinations to any single viewer, spread across several sessions. It was therefore decided to create three sets of viewing tapes (designated as the "Red", "Green" and "Orange" sets, or R, G and O, for short), each set of tapes containing all the scenes, but only one-third of the HRC's, in all possible combinations. Any given viewer will see exactly one set of tapes.

Referring to the HRC's by number in accordance with document T1A1.5/92-174 (see Appendix D), we allocated the HRC's to the sets of viewing tapes as follows:

Red Tape Set:	1, 4, 7, 8, 13, 15, 19, 20, 22, 24
Green Tape Set:	2, 5, 6, 10, 14, 15, 16, 17, 20, 23
Orange Tape Set:	3, 4, 9, 11, 12, 17, 18, 20, 21, 25

This allocation was guided by a desire to include the full range of video performance in each tape set, observing that the HRC's fall into 9 general types according to their engineering descriptions (see Table 3). In particular:

— An even division was achieved among codec types and transmission rates.

— Each tape set has 2 or 3 proprietary HRC's, 1 or 2 QCIF HRC's, 5 CIF HRC's (not counting the Null or VHS HRC).

— Each tape set contains one HRC with transmission errors.

Additionally, the four remaining HRC's that had been set aside at the start were given special treatment by being included in more than one tape set, each. The purpose is to allow post-hoc calibration checks between the tape sets. They were allocated to the tape sets as follows:

TAPES	HRC No.	Description
R,G,O	20	Identical Px64 Codecs at 384 kB/s
R,G	15	Identical Px64 Codecs at 112 kB/s
G,O	17	Different Px64 Codecs at 128 kB/s
R,O	4	Vector Quantiz. Codec at 128 kB/s

2.7.2 Allocation of Tape Sets to Testing Labs

Three different video labs volunteered to participate in the subjective viewing and data gathering phase of the study. Early thinking called for sending each of the three color-coded sets of tapes to just one lab, which would have allocated each HRC to just a single lab -- except for the four HRC's that are repeated across 2 or 3 labs. This plan had a

certain appeal in terms of its logistic simplicity, but it has the drawback that any inter-laboratory differences would have to be assessed, and possibly corrected for, using only a tiny fraction of the test material and data.

Other similar studies suggest that inter-laboratory differences might indeed occur -- either because of uncontrollable differences in the physical conditions of the test set-up, or because of differences in the sampled populations of viewers at the three locations. We did not want to be left with a set of data in which quantities of primary interest (HRC quality ratings) are essentially confounded with unmeasurable, irrelevant, and possibly inexplicable factors (collectively called "inter-laboratory differences"), merely because of weaknesses in the sampling design.

So the initial plan was abandoned in favor of a more balanced design, in which all of the color-coded tape sets are sent to each viewing lab. Every lab is instructed to divide its 30 test subjects randomly into three teams of 10 subjects each, for viewing the three sets of tapes. Thus, each lab will assemble a "Red Team", a "Green Team" and an "Orange Team". In the overall data set, the "Red Cohort" will be the union of the Red Teams from the three labs, and will be spread in equal numbers across the labs, and so on for the other colors. Schematically, we have:

Lab	Tapes	Viewers	Alternates
X	Red	X1 ... X10	X11 ... X20
	Green	X21 ... X30	X31 ... X40
	Orange	X41 ... X50	X51 ... X60
Y	Red	Y1 ... Y10	Y11 ... Y20
	Green	Y21 ... Y30	Y31 ... Y40
	Orange	Y41 ... Y50	Y51 ... Y60
Z	Red	Z1 ... Z10	Z11 ... Z20
	Green	Z21 ... Z30	Z31 ... Z40
	Orange	Z41 ... Z50	Z51 ... Z60

(N.B. the viewer sequence numbers above are their numbers *after* being randomized according to instructions in Section 2.9. The numbers for alternate viewers may not be completely used.)

Since the quantities of primary interest in the data analysis will be summaries across the cohorts, any laboratory-specific factors affecting judgements will be neutralized by being equally spread out across all results.

This plan turns a potential liability (inter-laboratory differences) into a strength: the pooled data set from the three labs can be regarded as a properly stratified random sample from a target population that is an equal-probability mixture of the target populations realized at the three labs. In this way, by going to three labs instead of one for test subjects, we are likely to broaden the scope of our sampled population and make it more

representative of the true potential market for video teleconferencing in the country.

This plan has the further desirable property that any given HRC has the same probability of being viewed by every test subject in the study, which justifies the use of unweighted averages across cohorts as efficient and unbiased estimates of population parameters.

Moreover, this design will also allow us to study the inter-laboratory differences themselves -- with a view to clarifying our understanding of the target sub-population that were *actually* sampled.

2.8 Stimuli Presentation Order

2.8.1 Number of Test Sessions

It was observed that with some slight modifications to the test method outlined in CCIR Rec. 500-5, the required number of stimuli that we must present to each viewer can be accommodated in 4 viewing sessions of 32.5 minutes each -- exceeding the CCIR recommendation by just 2.5 minutes. Each session will consist of

10 HRC's * 25 Scenes * 0.5 min/seq. = 125 min of testing

125 min / 4 sess = 31.25 min/sess

To each session, we add 1 minute for two additional calibration checks (one repeated combination and one Null combination). This gives an average of 32.25 min per session, or two sessions with 32.5 minutes and two with 32.0 minutes.

2.8.2 Randomization Within Test Sessions

Principles of good experimental design require that all the test combinations shown to a viewer be randomly permuted over the viewer's four session tapes. This permits each session to exhibit a full range of video quality and mitigates artifacts due to presentation order (learning or fatigue effects, adjacency effects, etc).

Ideally, we might want each viewer to be presented with an independent randomization of the stimuli, but we are constrained by the need to prepare each session as a pre-edited 1/2 hour video tape, so we plan to use the same 1/2 hour tapes (and hence the same randomization sequence for each 1/2 hour tape) for all the viewers presented with the same selection of HRC's. The presentation order for the four session tapes will be randomized as per section 2.9.1.

The order of presentation of the stimuli can influence the opinion of the evaluators in subtle ways. Therefore, although a randomized order of presentation is necessary, it may not be sufficient. Following the CCIR guidelines, we arranged for consecutive stimuli to be dissimilar on each of the two design dimensions, meaning that not only the pictorial content but also the transmission impairments caused by the characteristics of the HRC's varies. This was achieved by making some minor modifications to the randomization process which take into account the grouping of HRC's into 9 types, and a grouping of the 25 scenes into 5 categories with similar pictorial content, shown in Table 2.

Table 2 identifies each scene by its short process name and the lower case letter used in the test matrix on Table 1.

Table 2. SCENE CONTENT CATEGORIES

CONTENT CATEGORY	DESCRIPTION	SCENE NAMES & LETTERS
A	One person, mainly head and shoulders	vtclnw(f), susie(j), disguy(k), disgal(l)
B	One person with graphics and/or more detail	vtcmp(a), vtc2zm(b), boblec(e), smity1(m), smity2(n), vowels(w)
C	More than one person	3inrow(d), 5row1(g), intros(o), 3twos(p), 2wbord(q), split6(r)
D	Graphics with pointing	washdc(c), cirkit(s), roadmap(t), filter(u), ysmite(v), inspec(x)
E	High object and/or camera motion (Examples of Broadcast TV)	flogar(h), ftball(i), fredas(y)

Table 3 divides the 25 HRC's into 9 groups according to the transmission quality and type of impairments that are to be expected. Some revisions may be desirable after the processed tapes have been reviewed.

Table 3. REFERENCE CIRCUIT GROUPS

GROUP NO.	CIRCUIT DESCRIPTION	HRC NO.
1	High Quality	1-3
2	Vector Quantization, medium rate	4-5
3	Proprietary, low to medium rate	6-7
4	Proprietary, medium to high rate	8-10
5	QCIF, low rate	11-13
6	QCIF, medium rate	14
7	CIF, low rate	15-18
8	CIF, medium rate	19-21
9	CIF, high rate	22-25

Each processed test scene, also called a test combination, was then assigned a number and letter code (such as 5-B) roughly categorizing pictorial content and transmission circuit characteristics.

In terms of these categories and this notation, the randomization process was performed in the following steps, using sampling without replacement, subject to certain constraints:

1. All test scenes processed through the 10 HRC's assigned to one set of viewing tapes were put into a pool (the number 10 includes the 7 exclusively assigned to that set, plus the 3 that are shared across sets).
2. Randomly, a test scene was pulled and its code checked.
3. If both number and letter were different from the preceding scene, it was accepted.
4. If either the number or letter were the same, it was returned to the pool and another scene was pulled, until one was found that was accepted.
5. This was continued until all spaces on the tape (either 64 or 65) were filled.
6. The whole process above was then continued for the next session tape in the set, using the remaining combinations.

This selection process results in four well-randomized tapes for each HRC set. We anticipated some difficulties in satisfying the adjacency constraints toward the end when only a few scenes remained in the pool. Judicious exchange with previously assigned scenes made it easy to solve this problem.

With 64 or 65 stimuli per tape and only 10 HRC's per tape, the above described randomizing process produced a healthy balance of HRC's across the four session tapes in each set.

Special attention was given to the scenes which are to be used for quality checks since their number is held to a minimum to avoid excessive disqualifications. The Null circuit scenes will be judged by viewers primarily in terms of resolution and color fidelity, since motion rendition is a minor factor. Therefore, scenes washdc(c), flogar(h), cirkit(s), and rodmap(t) were prime candidates for this purpose. One was assigned to each session tape. Scenes selected for repetition were typical and average ones, especially those with the content/quality code 8-C or 9-D.

The location of Null circuit and repeated scenes on the tape were not determined by the randomization process described above. Instead, locations were picked judiciously, by hand, to ensure that each session tape contains one of each and that all other constraints were satisfied. These locations were different on each session tape.

The above randomization prescriptions produced a satisfactory sequence of scenes on each tape, but one further level of randomization was adopted to further neutralize potential order-of-presentation artifacts -- a block randomization achieved by presenting the four session tapes in a different randomized order to different sets of 1, 2, or 3 viewers, as described in Section 2.9.1.

2.9 Procedures for Randomized Tape Viewing and Selection of Viewer Groups

The following guidelines for the subjective testing laboratories specify how to divide the pool of viewers into session sub-teams and what tape presentation order to use for each of the sub-teams. The intent of these guidelines is to minimize systematic differences which could lead to biases in HRC ratings. Whenever possible, the testing laboratories should use these guidelines. Any exceptions to these guidelines will be recorded (Appendix G gives an alternative method for random selection of viewer groups that will

be used at one or more labs). Here the labs are identified as X, Y, Z and the tapes as R1, R2, R3, R4; G1, G2, G3, G4; O1, O2, O3, O4.

2.9.1 Random Ordering of Session Tapes

To allow for the possibility of tape sharing between the labs, it is assumed that each set of four tapes will be viewed in succession without interruption by other tapes. The order which teams view the tapes is determined randomly subject to balance. Using Tables of Random Permutations by L.E. Moses and R.V. Oakford (Stanford University Press, 1963) yields the following chronological order of the tape sets:

Table 4. CHRONOLOGICAL ORDER OF TAPE SETS

Lab X:	G O R
Lab Y:	O R G
Lab Z:	R G O

Costs permitting, a complete set of tapes will be prepared for each lab to facilitate scheduling. Each of the 9 teams of viewers given above must have at least 10 viewers. The four tapes shown to each of the nine teams are to be ordered in a random fashion. Since each session can have at most 3 viewers, at least 4 random tape orderings for each group of 10 viewers is possible. For all 9 groups, this gives a total of 4 x 9 = 36 orders. There are 4!=24 permutations of the integers 1,2,3,4. It seems reasonable to use all 24 permutations and include random duplicates of 12 of them. This is done by using Table 1 of Moses and Oakford, which consists of 960 permutations of 1,2,...,9, ignoring the numbers 5 through 9, copying the successive orders of 1,2,3,4, deleting any order that arises more than twice, and accepting exactly 12 duplicates as they arise until 36 are obtained:

Table 5. TAPE ORDER PERMUTATIONS

1423	2134	3214	1432	3421	4321	[1423]	4231	1342
1234	2143	3412	3124	4123	[1234]	2413	2314	[2134]
3142	[2314]	[1342]	4213	[3124]	[3412]	[3142]	[2413]	[2431]
[4231]	[4321]	1243	2431	2341	1324	4132	4312	3241

Hence the orders in which the tapes are to be viewed are as follows, proceeding from left to right and line by line:

Table 6. VIEWING ORDER FOR SUB-TEAMS BY LAB

Lab X:

G1	G4	G2	G3	G2	G1	G3	G4	G3	G2	G1	G4	G1	G4	G3	G2
O3	O4	O2	O1	O4	O3	O2	O1	O1	O4	O2	O3	O4	O2	O3	O1
R1	R3	R4	R2	R1	R2	R3	R4	R2	R1	R4	R3	R3	R4	R1	R2

Lab Y:

O3	O1	O2	O4	O4	O1	O2	O3	O1	O2	O3	O4	O2	O4	O1	O3
R2	R3	R1	R4	R2	R1	R3	R4	R3	R1	R4	R2	R2	R3	R1	R4
G1	G3	G4	G2	G4	G2	G1	G3	G3	G1	G2	G4	G3	G4	G1	G2

Lab Z:

R3	R1	R4	R2	R2	R4	R1	R3	R2	R4	R3	R1	R4	R2	R3	R1
G4	G3	G2	G1	G1	G2	G4	G3	G2	G4	G3	G1	G2	G3	G4	G1
O1	O3	O2	O4	O4	O1	O3	O2	O4	O3	O1	O2	O3	O2	O4	O1

2.9.2 Random Selection of Viewer Groups

Each lab will assemble a pool of viewers, about one-third of whom will view the R tapes, another third the G tapes, and the remaining third the O tapes. Since not more than three viewers will participate at any session, there will be at least four sub-teams of viewers of R tapes, four of G tapes, and four of O tapes at each lab, 12 non-overlapping sub-teams at each lab. The following discussion assumes sub-teams of size three. Even if all members of a sub-team do not view the tapes at the same time, they must view them in the same order.

The viewers shall be assigned to sub-teams at random to avoid systematic differences between the R, G, and O teams, which could lead to biases in HRC ratings. Each lab shall list its viewers in alphabetical order and assign the numbers 1,2,... in that order.

Three tables of random permutations of 1,2,...,50 from Moses and Oakford are shown below. Lab X is to use the first permutation, Y the second, and Z the third, going down the columns and disregarding any numbers beyond the available number of viewers. If Lab X has 36 viewers, then its first sub-team has viewers No. 8, 3, 5; its second No. 13, 10, 27; its third No. 34, 12, 25; its fourth No. 14, 4, 23; its fifth No. 15, 18, 2; etc.

This means that the first sub-team at Lab X, viewers 8, 3, 5, will view the G tapes in the order G1 G4 G2 G3; the second sub-team of Lab X, viewers 13, 10, 27, will view the G tapes in the order G2 G1 G3 G4; the third sub-team in the order G3 G2 G1 G4; and the fourth sub-team in the order G1 G4 G3 G2. The fifth sub-team at Lab X will view the O tapes in the order O3 O4 O2 O1, etc., up to the twelfth sub-team at Lab X, which will view the R tapes in the order R3 R4 R1 R2.

Similarly Lab Y will choose 12 sub-teams according to the second permutation. If it has 37 viewers available, its first sub-team of three consists of viewers No. 24, 16, 36; its second, No. 21, 15, 2; its third, No. 11, 20, 31; etc.

Similarly Lab Z will choose 12 sub-teams according to the third permutation. If it has 36 viewers available, its first sub-team consists of viewers No. 22, 9, 15; etc.

Table 7. RANDOM VIEWER ASSIGNMENT TO SUB-TEAMS

Lab X

8	27	4	2	26	48	38	46	9	39
3	34	23	21	6	50	37	40	16	19
5	12	15	7	32	49	30	42	11	31
13	25	18	43	28	22	29	41	1	35
10	14	44	20	36	47	17	45	33	24

Lab Y

24	2	31	19	46	17	37	13	28	33
16	41	3	43	1	7	18	30	39	27
36	11	10	8	44	26	12	23	47	34
21	49	50	38	25	4	5	32	9	40
15	20	6	45	22	29	14	42	35	48

Lab Z

22	15	31	12	5	24	14	29	45	30
39	44	43	41	16	8	21	35	49	37
40	18	28	47	11	33	36	20	42	26
9	38	7	17	46	25	23	2	4	19
48	13	50	34	6	10	32	27	3	1

3. PRE-TEST PROCEDURES

1. All viewers will complete a pre-test questionnaire (See Appendix C).
   Note: The subject demographic data will be examined only if the need arises, such as if differences emerge in the Lab to Lab calibration checks and possible reasons are sought for the differences. However, the 3 test labs will need to examine the question on video telephony usage, to ensure that they have met the sample experience requirement.

2. All viewers will complete vision acuity tests at the (6H) viewing distance, and color tests at the distance recommended in the color test procedure. The specific test for acuity is a Graham-Field Catalog # 13-1240 single letter identification chart, or equivalent, and modified for use at 6H distance. The specific test for color vision is the Pseudo-Isochromatic Plates for Testing Color Perception, as supplied by Beck Engraving Co., for example.

3. At each session, Labs will record the session number, tape number, viewing position(s), and time of day.

4. Instructions must be standardized and delivered on tape. Appendix A gives the text of the Instructions.

5. There will be a practice session, consisting of 6 cycles through the viewing and voting process. The range of quality displayed to the subjects will represent nearly the full range of quality in the experiment and will also contain one combination with transmission errors. In the spirit of conforming with CCIR 500-5, there will be a 2 minute break between practice and test sessions.

6. During subsequent sessions, the subjects will again view the practice tape sequence prior to the new material. There should be no need to practice voting in these sessions.

4. TEST SESSIONS

4.1 Considerations

1. Test scene numbers must be announced prior to the sequence.
2. Audio cues to vote will be included.
3. Use voting forms as shown in Appendix B.

4.2 Session Scheduling

The scheduling of the test sessions (time of day, rest between sessions, etc.) can affect the test results. Compliance with CCIR 500-5 and availability of test personnel can produce significant constraints on the time at which each test is performed.

Scheduling of individual test sessions, in terms of the number of sessions per week per subject is left to each individual lab's discretion. There will be a 15 minute break between sessions in a pair, and a 1 minute break during each session. There will be at least 1/2 day rest between pairs of test sessions.

Test personnel should not change between sessions.

4.3 Viewing Conditions

In preparing the viewing conditions, the test labs will use Section 2 of CCIR 500-5 as a guideline. All viewing will be conducted at a distance equal to 6 picture heights (6H).

The viewing monitor used at each test lab will be the SONY BVM-1910 or equivalent.

The format of the session tapes will be Betacam SP.

The SMPTE color bars alignment signal will be available on tape.

5. INITIAL ANALYSIS OF SUBJECTIVE DATA

The purpose of this section is to define the data processing and initial analysis that will be performed on the data obtained from the subjective tests. The steps described in subsections 5.1 through 5.6 are to be performed at each lab on the data obtained at that lab.

5.1 Data Entry

The inputs to the Data Analysis function are the score sheets filled in by the test observers (viewers) at each of the 3 labs. At each lab, there will be 30 primary viewers, allocated into 3 teams of 10 each, and possibly some number of alternates or replacements for each team. The teams are coded as Red, Green and Orange, corresponding to the color-coding of the video tapes they will view. The tapes come in sets of 4 for the 4 sessions that each viewer will attend. For each viewer and each session there will be 64 or 65 opinion scores. Each score will be assigned an integer from 1 to 5. For the total experiment there will be 23,220 opinion scores (not counting disqualified viewer and surplus alternates). The original score sheets will be duplicated, and the original sheets will be stored at a central location (place TBD). All further processing will be performed on the copies.

The data from each score sheet will be keyed into a computer. The data on each sheet consists of the test observer ID, the lab ID, the session number, and 64 or 65 opinion scores. Data will be keyed in by two independent operators, and a computer program will verify that the entered data is consistent.

Laboratories should coordinate the keying procedure to simplify interlab exchange of data (e.g., ASCII).

5.2 Convert Presentation Sequence

The randomization sequences for each lab, as shown in Appendix F, will be made available by Delta Information Systems in WordPerfect format. These sequences will be converted by each lab to a format that can be used for its computer program.

5.3 Perform Null and Repeat Quality Checks

Each lab will analyze its own data to determine the quality of the scores given by each test observer.

In each test session there is a Null (designated #0 in Appendix F) inserted to test the observer. If on any of these Nulls the observer gives a score of 3.0 or less, the observer will be disqualified.

In each test session one combination of HRC and scene is repeated. If for any repeated combination the absolute difference between the two opinion scores given by a test observer is 3.0 or more, the observer will be disqualified.

Alternate viewers for each team (if any) are initially marked as disqualified. Some number of them will subsequently be marked as qualified if they pass the two quality checks and if they are needed to replace disqualified primary team members.

5.4 Reformat the Data

Using the keyed-in score data and the presentation sequences for each session, each lab will use a computer spreadsheet program to reformat the data into a series of tables as shown below.

In each session, there is one combination that is repeated twice; the score from the first occurrence shall be entered into the main body of the table, and the second shall be entered into the "REPEAT" column.

5.5 Compute Summary Statistics Per HRC

For each of the reformatted tables (HRCs) obtained from Section 5.4, the following calculations are performed by computer at each lab:

The average and sample standard deviation of each column (scene) are calculated across all qualifying rows, and displayed to two decimal places in the table.

The standard error of the mean of each column is calculated as the standard deviation calculated above divided by the square root of the number of qualifying values in the column, and displayed.

LAB _____ HRC NO. _____

TEAM	-- VIEWER -- ID	QUALIFY?	SCENE a	b	c	d	e	...	w	x	y	-- REPEAT -- SCENE	SCORE
RED	1	1											
	2	1											
	...												
	10	1											
(ALT.)	11	0											
	12	0											
	...												
	20	0											
GREEN	21	1											
	22	1											
	...												
	30	1											
(ALT.)	31	0											
	32	0											
	...												
	40	0											
ORANGE	41	1											
	42	1											
	...												
	50	1											
(ALT.)	51	0											
	52	0											
	...												
	60	0											
MEAN													
S.D.													
S.E.													
MAX													
MIN													

The maximum and minimum qualifying value in each column are determined and displayed.

5.6 Lab-to-Lab Analysis

Up to this point, all analysis will be performed by each lab on the data that it has gathered. From this point on, the data will be analyzed as a whole. The results obtained from Sections 5.4 and 5.5 will be distributed to all concerned parties for further analysis.

Qualifying data from the various labs will be studied for interlab consistency, and pooled in a statistically suitable fashion, to produce the tabulation below for use in the next (objective) phase of the study.

Plans for further data analysis will be presented in future T1A1.5 contributions.

SUBJECTIVE TEST RESULTS

		SCENE a b c d e ..... x y
HRC		
1	mean s.d. s.e. max min	
2	mean s.d. s.e. max min	
3		
25	mean s.d. s.e. max min	

NOTE: s.d. estimate of standard deviation of observer population
s.e. estimate of standard error of mean
max largest observed opinion score
min smallest observed opinion score

6. AD HOC GROUP MEMBERSHIP

The complete list of Detailed Test Plan Ad Hoc Group members and Data Analysis Plan Ad Hoc Group members can be found in Appendix E.

APPENDIX A - Instructions to Test Subjects

Instructions for Initial Session

The ANSI Standards Committee on Telecommunications is conducting a study to determine how different video telephony systems affect the delivered quality. Today we are asking you to help us measure the quality of the video scenes you are about to see.

We are not asking you to rate the content of the scenes, the artistic composition nor the quality of the acting. Rather, we are asking for your rating of the quality of the video image itself.

You will be shown two versions of the same video scene. The first version will be the original scene. The second version will be the original passed through a video transmission system. You are asked to rate the difference in quality that you perceive between the two versions. As shown on your rating form, please score the differences as either Imperceptible (when you cannot see a difference between the first and second versions), Perceptible but not Annoying, Slightly Annoying, Annoying, or Very Annoying.

You should mark your rating form as indicated on the practice sheet. Note that response ovals for each scene pair are arranged in a vertical column below the scene number. Mark only one oval for each scene pair.

Remember, there are no right and wrong answers. We are interested in how you, personally, perceive the difference between the two versions. It is not necessary to think long about your answer. However, please watch the entire scene before scoring. Please do not discuss the scenes with your fellow viewers. Your first reaction is what we wish you to record.

We now begin the Practice Section. Use the your rating form labeled "Practice Section" and mark the appropriate oval for the following six pairs of scenes. The practice session displays representative examples of video quality in the test.

The announcer will give the number of each pair of scenes before it appears. After viewing each scene pair, the announcer will ask you to rate the video quality.

We now begin the rating process for the Practice Section.

Here is scene 1. (speak quickly)

.
.
.

Please score scene 1.

...
...
...
...

Here is scene 6.

.
.
.

Please score scene 6.

That completes the Practice Section. We will begin the First Section in a few moments.

Instructions for Follow-on Sessions

Welcome back to the Video Viewing Lab.

Today's session will be similar to your last session with us.

You will be shown two versions of the same video scene. The first version will be the original scene. The second version will be the original passed through some video system. You are asked to rate the difference in quality that you perceive between the two versions. As shown on your rating form, please score the differences as either Imperceptible (when you cannot see a difference between the first and second versions), Perceptible but not Annoying, Slightly Annoying, Annoying, or Very Annoying.

Please watch the entire scene before scoring, and do not discuss the scenes with your fellow viewers. Your first reaction is what we wish you to record.

The announcer will give the number of each pair of scenes before it appears. After viewing each scene pair, the announcer will ask you to rate the video quality.

We now begin the Practice for the First Section. You should mentally score the scenes in this sequence, but do not mark your rating form at this time.

Instructions for Viewing Session Tapes

We now begin the rating process for the First Section.

Here is scene 1.

.
.
.

Please score scene 1.

...
...
...
...

Here is scene 30.

.
.
.

Please score scene 30.

That completes the First Section. We will begin the Second Section in a few moments.

(60 second break)

We now begin the rating process for the Second Section.

("Here is scene 31" and so on to scene 64 or 65)

That completes the Second Section.

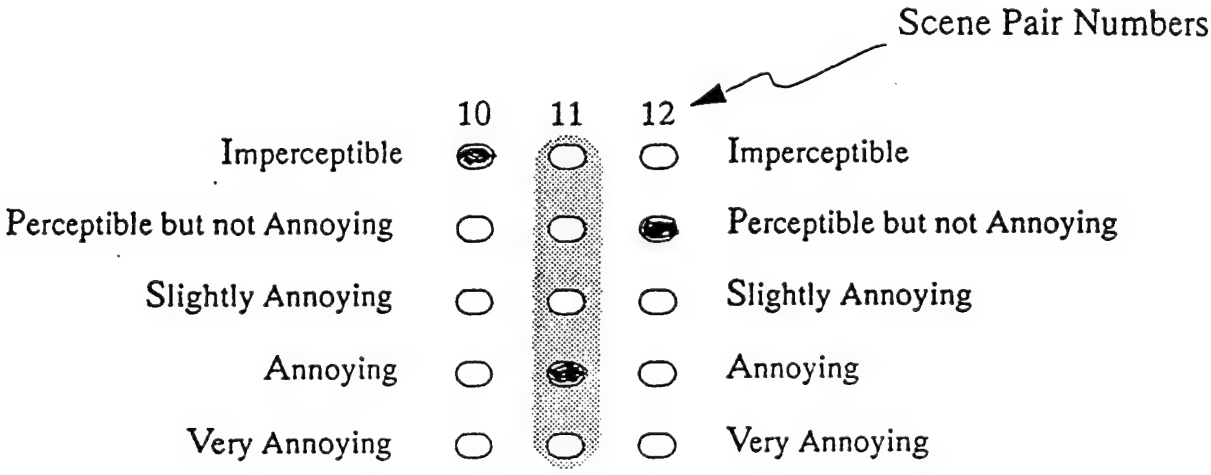
This concludes today's video quality rating session. We look forward to seeing you again for the next video quality rating session.

APPENDIX B - PRACTICE and VOTING FORMS

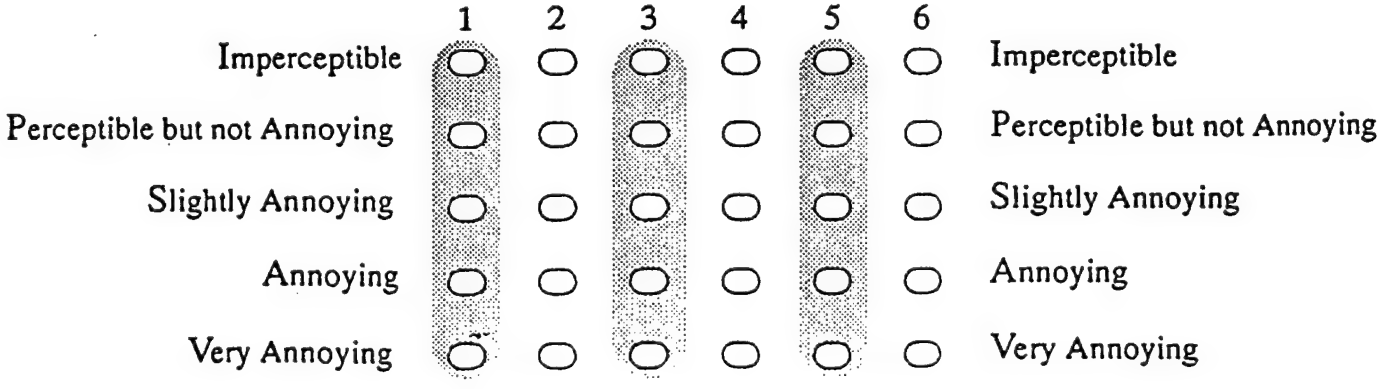
Viewer Rating Practice Form

You will be shown two versions of the same video scene. The first version will be the original scene. The second version will be the original passed through some video system. Rate the difference between the two versions by marking one of the five ovals. See the examples below which show typical markings for 3 scene pairs.

Marking Examples



Practice Scenes



APPENDIX B - PRACTICE and VOTING FORMS

	1	2	3	4	5	6	
Imperceptible	○	○	○	○	○	○	Imperceptible
Perceptible but not Annoying	○	○	○	○	○	○	Perceptible but not Annoying
Slightly Annoying	○	○	○	○	○	○	Slightly Annoying
Annoying	○	○	○	○	○	○	Annoying
Very Annoying	○	○	○	○	○	○	Very Annoying

Date _____ Time _____ Evaluator No. _____ Viewing Position _____ Tape No. _____

Signature _____

(Name)

APPENDIX C - PRE-TEST QUESTIONNAIRE

Please answer the following questions: NAME_____

1. Circle your age range:
   10-19 20-29 30-39 40-49 50-59 60-69 70-79 80-89

2. Circle your Gender:
   Male Female

3. Indicate your occupation according to industry and job: (Mark one in each column)

INDUSTRY	JOB
_____Accounting/Legal/Consulting	_____Administrative/White Collar
_____Advertising/Public Relations	_____Clerical/Support
_____Agriculture/Forestry	_____Driver
_____Broadcasting/Newspapers	_____Executive/Managerial
_____Construction/Contracting	_____Farmer/Forester
_____Education	_____Homemaker
_____Electronics/Computers	_____Industrial Worker
_____Engineering/Architecture	_____Laborer
_____Entertainment	_____Maintenance
_____Finance/Insurance	_____Owner/Operator
_____Government	_____Police/Military
_____Health Care/Social Services	_____Professional
_____Manufacturing/Printing	_____Rancher/Fisher
_____Military	_____Sales/Marketing
_____Mining/Oil/Gas	_____Secretarial
_____Personal/Business Services	_____Semi-Professional Services
_____Real Estate	_____Skilled Trades
_____Religion	_____Student
_____Restaurants/Lodging	_____Technical
_____Retail	_____Unemployed
_____Retired	
_____Security/Services/Police	
_____Telecommunication/Utilities	
_____Transportation	
_____Wholesale	
_____None	

4. Have you previously participated in video telephony, or in a video teleconference? (Mark one answer)

   — Yes, within the last 2 years.

   — Yes, but not within the last 2 years.

   — No.

APPENDIX D - TABLE OF HYPOTHETICAL REFERENCE CIRCUITS

This table first appeared in document T1A1.5/92-174. As permited in their charter, the Testing Ad Hoc Group (H. Meiseles, Vyvx, Chair; S. Gallaher, Vyvx; A. Morton, AT&T Communications) modified the table slightly to comply with the limitations of the available equipment. The modified version appears below.

HYPOTHETICAL REFERENCE CIRCUITS

HRC	Algorithm (vendor)	Resolution	Total, Kbps	Audio, Kbps	Video, Kbps	Coding Mode	Frame Rate	FEC	Burst Errors
1	Null	-	-	-	-	-	-	-	Off
2	VHS	-	-	-	-	-	-	-	Off
3	Proprietary	V.High	45,000	-	-	-	-	-	Off
4	Proprietary	Med.	128	-	-	VQ	-	-	Off
5	Proprietary	High	336	-	-	VQ	-	-	Off
6	Proprietary	Med.	112	-	-	-	-	-	Off
7	Proprietary	Med.	384	-	-	-	-	-	Off
8	Proprietary	Med.	768	-	-	-	-	-	Off
9	Proprietary	High	768	-	-	-	-	-	Off
10	Proprietary	High	1536	-	-	-	-	-	Off
11	H.261(diff)	QCIF	128	56	70.4	INTER+MC	-	On	Off
12	H.261(same)	QCIF	128	56	70.4	INTER	10*	On	Off
13	H.261(same)	QCIF	168	48	118.4	INTER+MC	-	On	Off
14	H.261(diff)	QCIF	384	56	326.4	INTER+MC	-	On	Off
15	H.261(same)	CIF	112	48	62.4	INTER+MC	-	On	Off
16	H.261(same)	CIF	128	56	70.4	INTER+MC	-	On	Off
17	H.261(diff)	CIF	128	48	78.4	INTER+MC	-	On	Off
18	H.261(same)	CIF	168	48	118.4	INTER+MC	-	On	Off
19	H.261(same)	CIF	256	56	190.4	INTER+MC	15*	On	On
20	H.261(same)	CIF	384	56	326.4	INTER+MC	-	On	Off
21	H.261(same)	CIF	384	56	326.4	INTER+MC	-	On	On
22	H.261(diff)	CIF	768	56	710.4	INTER+MC	-	On	Off
23	H.261(same)	CIF	768	56	710.4	INTER+MC	-	On	On
24	H.261(diff)	CIF	1536	56	1478.4	INTER+MC	-	On	Off
25	H.261(same)	CIF	1536	56	1478.4	INTER+MC	-	On	Off

* Specified value. Actual frame rate may be determined through measurement.

APPENDIX E - DETAILED TEST PLAN AD HOC GROUP MEMBERS

NAME	REPRESENTING
Al Morton	AT&T Communications (Chair)
Tony Schiano	AT&T Communications
David Hayner	Ameritech Srvcs
Keith Kommeyer	Bell Atlantic
Ron McConnell	BellCore
Dan Wirth	BellCore
Dan Klenke	Compression Labs, Inc
R. Schaphorst	Delta Information Sys
Neil Randall	Delta Information Sys
John Roth	Delta Information Sys
Greg Cermak	GTE Labs
Eric Hauch	Government of Canada
Stephen Wolf	NTIA/ITS.N3
Rich Baker	PictureTel Corp
Robert Reynolds	(formally) PictureTel Corp
Xian-Cheng Yuan	PictureTel Corp
Greg Onyszchuk	Telecom Canada
Doug Stevens	Tektronix
John Grigg	US West
Joe Duran	VTEL

DATA ANALYSIS AD HOC GROUP MEMBERS

NAME	REPRESENTING
Richard Schaphorst	Delta Information Sys (Convener)
Bill Coufal	US West (Secretary)
Al Morton	AT&T Communications
Paul Tukey	BellCore
Dan Wirth	BellCore
C.Frank Taylor	Bell South
Neil Randall	Delta Information Sys
Greg Cermak	GTE Labs
Eric Hauch	Government of Canada
Edwin Crow	NTIA/ITS.N3
Arthur Webster	NTIA/ITS.N3
Stephen Wolf	NTIA/ITS.N3
Rich Baker	PictureTel Corp
Marshall Schachtman	PictureTel Corp

APPENDIX F - RANDOM PRESENTATION ORDERS

PRESENTATION ORDER -- RED TEAM TAPES

HRCs 1 4 7 8 13 15 19 20 22 24

	SESSION 1	SESSION 2	SESSION 3	SESSION 4
	Scene/Type	Scene/Type	Scene/Type	Scene/Type
1	13-f 5-A	19-k 8-A	22-n 9-B	15-s 7-D
2	20-i 8-E	1-s 1-D	4-f 2-A	13-q 5-C
3	4-q 2-C	7-b 3-B	7-u 3-D	7-a 3-B
4	19-x 8-D	19-j 8-A	8-o 4-C	8-q 4-C
5	15-l 7-A	*22-c 9-D	22-t 9-D	19-m 8-B
6	8-r 4-C	19-b 8-B	7-k 3-A	4-s 2-D
7	15-e 7-B	1-k 1-A	4-v 2-D	22-i 9-E
8	1-p 1-C	24-p 9-C	8-y 4-E	8-w 4-B
9	19-n 8-B	4-y 2-E	19-l 8-A	20-s 8-D
10	4-r 2-C	19-t 8-D	8-t 4-D	24-e 9-B
11	24-c 9-D	7-y 3-E	20-w 8-B	15-p 7-C
12	8-e 4-B	4-w 2-B	7-f 3-A	22-v 9-D
13	7-q 3-C	#0-t 1-D	20-n 8-B	15-j 7-A
14	15-m 7-B	13-i 5-E	7-h 3-E	20-y 8-E
15	13-g 5-C	24-l 9-A	4-d 2-C	#0-s 1-D
16	22-k 9-A	1-b 1-B	22-s 9-D	13-l 5-A
17	8-g 4-C	22-u 9-D	4-a 2-B	24-d 9-C
18	15-x 7-D	7-l 3-A	*19-p 8-C	8-m 4-B
19	1-r 1-C	19-d 8-C	24-n 9-B	24-r 9-C
20	7-t 3-D	22-b 9-B	19-o 8-C	13-a 5-B
21	13-w 5-B	4-x 2-D	1-t 1-D	19-h 8-E
22	15-f 7-A	19-r 8-C	8-a 4-B	13-d 5-C
23	1-w 1-B	22-x 9-D	20-f 8-A	19-u 8-D
24	8-v 4-D	8-p 4-C	24-g 9-C	7-i 3-E
25	4-h 2-E	4-j 2-A	8-i 4-E	19-v 8-D
26	22-l 9-A	7-r 3-C	13-c 5-D	24-h 9-E
27	20-x 8-D	*22-c 9-D	7-o 3-C	7-d 3-C
28	22-g 9-C	7-p 3-C	1-v 1-D	*24-x 9-D
29	8-j 4-A	8-c 4-D	8-l 4-A	13-y 5-E
30	22-h 9-E	7-w 3-B	1-m 1-B	7-n 3-B
31	*20-o 8-C	24-y 9-E	15-u 7-D	24-u 9-D
32	13-e 5-B	20-p 8-C	22-e 9-B	7-j 3-A
33	15-i 7-E	4-u 2-D	13-j 5-A	15-h 7-E
34	20-l 8-A	24-a 9-B	20-r 8-C	20-c 8-D
35	15-b 7-B	4-i 2-E	1-h 1-E	24-o 9-C
36	19-y 8-E	8-k 4-A	8-s 4-D	7-e 3-B
37	15-t 7-D	15-q 7-C	1-g 1-C	24-t 9-D
38	1-e 1-B	13-x 5-D	8-u 4-D	20-m 8-B
39	15-o 7-C	4-n 2-B	15-a 7-B	24-j 9-A
40	24-v 9-D	1-q 1-C	8-f 4-A	7-m 3-B
41	1-d 1-C	22-w 9-B	20-g 8-C	24-k 9-A
42	24-b 9-B	19-c 8-D	1-a 1-B	20-a 8-B
43	8-d 4-C	24-f 9-A	7-s 3-D	*24-x 9-D
44	20-u 8-D	1-y 1-E	4-b 2-B	13-o 5-C
45	24-i 9-E	13-t 5-D	*19-p 8-C	4-l 2-A

46	#0-c 1-D	24-q 9-C	1-f 1-A	15-y 7-E
47	19-q 8-C	20-b 8-B	19-s 8-D	19-f 8-A
48	7-v 3-D	1-x 1-D	24-w 9-B	4-m 2-B
49	19-i 8-E	8-n 4-B	15-v 7-D	22-q 9-C
50	*20-o 8-C	15-d 7-C	22-p 9-C	1-j 1-A
51	1-n 1-B	22-a 9-B	13-u 5-D	20-q 8-C
52	4-t 2-D	7-c 3-D	#0-h 1-E	22-m 9-B
53	13-h 5-E	4-p 2-C	8-b 4-B	4-k 2-A
54	20-t 8-D	1-u 1-D	4-g 2-C	15-w 7-B
55	24-m 9-B	4-e 2-B	22-j 9-A	1-o 1-C
56	20-v 8-D	24-s 9-D	8-h 4-E	15-c 7-D
57	13-r 5-C	13-b 5-B	15-r 7-C	1-i 1-E
58	19-e 8-B	19-g 8-C	1-l 1-A	7-x 3-D
59	15-k 7-A	1-c 1-D	13-m 5-B	22-y 9-E
60	4-c 2-D	13-k 5-A	4-o 2-C	20-j 8-A
61	20-e 8-B	22-o 9-C	20-k 8-A	13-s 5-D
62	7-g 3-C	15-n 7-B	13-v 5-D	20-h 8-E
63	8-x 4-D	13-p 5-C	19-w 8-B	22-r 9-C
64	20-d 8-C	22-f 9-A	15-g 7-C	13-n 5-B
65		19-a 8-B		22-d 9-C

PRESENTATION ORDER -- GREEN TEAM TAPES

HRCs 2 5 6 10 14 15 16 17 20 23

	SESSION 1	SESSION 2	SESSION 3	SESSION 4
	Scene/Type	Scene/Type	Scene/Type	Scene/Type
1	2-v 1-D	2-e 1-B	10-t 4-D	6-g 3-C
2	17-k 7-A	17-q 7-C	15-d 7-C	16-h 7-E
3	14-u 6-D	5-x 2-D	20-u 8-D	20-n 8-B
4	15-e 7-B	16-g 7-C	23-a 9-B	5-u 2-D
5	2-h 1-E	#0-c 1-D	*20-q 8-C	14-e 6-B
6	23-e 9-B	15-h 7-E	17-t 7-D	2-j 1-A
7	6-q 3-C	14-x 6-D	14-m 6-B	16-x 7-D
8	17-y 7-E	16-r 7-C	2-r 1-C	20-h 8-E
9	2-p 1-C	23-x 9-D	17-i 7-A	15-f 7-A
10	15-v 7-D	16-k 7-A	10-q 4-C	14-v 6-D
11	14-y 6-E	10-i 4-E	14-a 6-B	10-h 4-E
12	10-w 4-B	14-g 6-C	15-t 7-D	23-d 9-C
13	23-g 9-C	20-m 8-B	6-m 3-B	14-f 6-A
14	5-f 2-A	15-x 7-D	17-s 7-D	20-o 8-C
15	14-h 6-E	14-n 6-B	5-y 2-E	17-j 7-A
16	*20-d 8-C	17-u 7-D	16-p 7-C	#0-h 1-E
17	6-c 3-D	14-j 6-A	23-n 9-B	5-l 2-A
18	16-n 7-B	5-s 2-D	10-g 4-C	*23-s 9-D
19	5-g 2-C	17-n 7-B	6-k 3-A	16-e 7-B
20	6-e 3-B	23-i 9-A	2-g 1-C	10-f 4-A
21	5-o 2-C	20-g 8-C	6-u 3-D	6-w 3-B
22	17-e 7-B	16-a 7-B	20-y 8-E	14-l 6-A
23	20-f 8-A	20-i 8-E	10-r 4-C	20-r 8-C
24	17-o 7-C	16-j 7-A	16-c 7-D	10-n 4-B
25	6-v 3-D	2-b 1-B	6-l 3-A	6-j 3-A
26	20-a 8-B	10-d 4-C	23-p 9-C	23-q 9-C
27	6-p 3-C	6-h 3-E	#0-s 1-D	10-l 4-A
28	20-s 8-D	14-d 6-C	10-o 4-C	15-y 7-E
29	23-k 9-A	20-v 8-D	6-x 3-D	23-w 9-B
30	5-v 2-D	10-a 4-B	2-y 1-E	16-q 7-C
31	2-i 1-E	15-c 7-D	16-u 7-D	10-x 4-D
32	5-p 2-C	5-i 2-E	6-r 3-C	17-r 7-C
33	23-y 9-E	2-k 1-A	23-j 9-A	2-f 1-A
34	20-e 8-B	17-h 7-E	20-c 8-D	5-c 2-D
35	23-l 9-A	23-v 9-D	5-d 2-C	2-m 1-B
36	15-a 7-B	14-i 6-E	2-c 1-D	*23-s 9-D
37	10-v 4-D	17-f 7-A	17-l 7-A	5-n 2-B
38	15-p 7-C	10-c 4-D	*20-q 8-C	16-y 7-E
39	20-k 8-A	16-m 7-B	5-a 2-B	2-w 1-B
40	6-t 3-D	*23-u 9-D	20-l 8-A	16-s 7-D
41	15-k 7-A	10-e 4-B	14-t 6-D	23-f 9-A
42	14-r 6-C	14-s 6-D	6-i 3-E	6-s 3-D
43	10-b 4-B	23-h 9-E	5-k 2-A	14-p 6-C
44	16-d 7-C	6-b 3-B	15-q 7-C	5-m 2-B
45	6-y 3-E	15-l 7-A	14-c 6-D	15-s 7-D
46	17-x 7-D	23-t 9-D	6-o 3-C	14-o 6-C
47	2-n 1-B	15-o 7-C	2-l 1-A	17-m 7-B

48	20-p 8-C	20-b 8-B	15-n 7-B	14-k 6-A
49	16-b 7-B	17-c 7-D	20-j 8-A	20-t 8-D
50	2-u 1-D	14-w 6-B	16-t 7-D	17-a 7-B
51	5-h 2-E	23-o 9-C	6-a 3-B	23-r 9-C
52	23-b 9-B	10-j 4-A	5-t 2-D	10-y 4-E
53	17-d 7-C	16-w 7-B	17-w 7-B	5-j 2-A
54	6-f 3-A	2-d 1-C	10-p 4-C	15-w 7-B
55	16-v 7-D	15-i 7-E	5-e 2-B	10-s 4-D
56	14-q 6-C	5-q 2-C	6-d 3-C	15-j 7-A
57	23-m 9-B	16-i 7-E	16-f 7-A	2-q 1-C
58	*20-d 8-C	2-x 1-D	10-m 4-B	15-b 7-B
59	2-a 1-B	16-o 7-C	2-t 1-D	23-c 9-D
60	5-r 2-C	10-k 4-A	6-n 3-B	17-b 7-B
61	16-l 7-A	15-u 7-D	2-s 1-D	10-u 4-D
62	#0-t 1-D	5-b 2-B	14-b 6-B	5-w 2-B
63	17-p 7-C	15-r 7-C	17-v 7-D	17-g 7-C
64	20-x 8-D	*23-u 9-D	2-o 1-C	20-w 8-B
65		15-m 7-B		15-g 7-C

PRESENTATION ORDER -- ORANGE TEAM TAPES

HRCs 3 4 9 11 12 17 18 20 21 25

	SESSION 1	SESSION 2	SESSION 3	SESSION 4
	Scene/Type	Scene/Type	Scene/Type	Scene/Type
1	4-v 2-D	20-t 8-D	*21-o 8-C	21-b 8-B
2	20-i 8-E	4-g 2-C	3-i 1-E	11-r 5-C
3	3-s 1-D	25-n 9-B	25-c 9-D	21-k 8-A
4	4-y 2-E	17-v 7-D	9-w 4-B	#0-t 1-D
5	9-n 4-B	3-o 1-C	17-j 7-A	17-d 7-C
6	20-y 8-E	4-s 2-D	4-d 2-C	9-s 4-D
7	17-x 7-D	18-w 7-B	21-s 8-D	4-j 2-A
8	12-f 5-A	25-p 9-C	9-l 4-A	12-o 5-C
9	9-q 4-C	20-e 8-B	25-d 9-C	18-v 7-D
10	20-h 8-E	4-q 2-C	11-l 5-A	11-q 5-C
11	25-m 9-B	3-k 1-A	21-a 8-B	20-v 8-D
12	#0-h 1-E	9-h 4-E	11-u 5-D	3-e 1-B
13	18-k 7-A	12-x 5-D	4-k 2-A	12-q 5-C
14	11-m 5-B	20-d 8-C	11-t 5-D	3-m 1-B
15	18-p 7-C	3-u 1-D	3-r 1-C	12-p 5-C
16	3-t 1-D	9-b 4-B	9-c 4-D	3-a 1-B
17	21-g 8-C	25-y 9-E	4-o 2-C	18-g 7-C
18	3-h 1-E	3-b 1-B	20-w 8-B	4-l 2-A
19	9-o 4-C	17-r 7-C	25-u 9-D	9-i 4-E
20	21-w 8-B	25-x 9-D	18-y 7-E	20-o 8-C
21	17-f 7-A	3-g 1-C	25-g 9-C	9-j 4-A
22	3-y 1-E	17-e 7-B	20-u 8-D	18-e 7-B
23	9-a 4-B	12-i 5-E	12-e 5-B	*20-p 8-C
24	11-f 5-A	25-r 9-C	20-k 8-E	17-n 7-B
25	4-c 2-D	20-l 8-A	11-g 5-C	3-c 1-D
26	17-y 7-E	9-r 4-C	21-f 8-A	11-p 5-C
27	11-n 5-B	18-x 7-D	4-a 2-B	20-x 8-D
28	25-f 9-A	9-m 4-B	25-t 9-D	12-a 5-B
29	20-g 8-C	18-h 7-E	4-b 2-B	18-f 7-A
30	11-c 5-D	21-d 8-C	21-u 8-D	25-h 9-E
31	25-l 9-A	25-i 9-E	12-n 5-B	4-e 2-B
32	12-y 5-E	*21-p 8-C	4-i 2-E	9-p 4-C
33	25-j 9-A	17-t 7-D	*21-o 8-C	4-f 2-A
34	3-x 1-D	25-o 9-C	18-u 7-D	9-y 4-E
35	18-o 7-C	17-w 7-B	9-d 4-C	11-b 5-B
36	21-m 8-B	21-y 8-E	11-y 5-E	4-p 2-C
37	12-l 5-A	25-e 9-B	3-p 1-C	18-t 7-D
38	20-r 8-C	21-q 8-C	12-t 5-D	11-j 5-A
39	4-n 2-B	11-w 5-B	21-i 8-E	18-a 7-B
40	*25-v 9-D	9-f 4-A	18-s 7-D	21-c 8-D
41	11-k 5-A	11-a 5-B	12-m 5-B	4-r 2-C
42	9-u 4-D	21-t 8-D	20-j 8-A	17-h 7-E
43	12-j 5-A	9-e 4-B	#0-c 1-D	20-a 8-B
44	17-m 7-B	12-s 5-D	18-b 7-B	17-k 7-A
45	4-x 2-D	20-m 8-B	21-r 8-C	12-b 5-B
46	18-l 7-A	17-p 7-C	9-k 4-A	20-c 8-D
47	11-d 5-C	9-x 4-D	17-a 7-B	25-q 9-C

48	17-l 7-A	21-n 8-B	12-k 5-A	18-i 7-E
49	3-v 1-D	12-g 5-C	20-n 8-B	11-o 5-C
50	20-q 8-C	25-w 9-B	25-k 9-A	20-f 8-A
51	9-t 4-D	18-d 7-C	21-v 8-D	11-h 5-E
52	3-d 1-C	4-w 2-B	9-g 4-C	21-j 8-A
53	12-v 5-D	25-s 9-D	17-c 7-D	3-n 1-B
54	3-q 1-C	11-e 5-B	21-h 8-E	4-u 2-D
55	21-x 8-D	4-h 2-E	3-l 1-A	18-m 7-B
56	11-i 5-E	17-b 7-B	11-s 5-D	12-d 5-C
57	17-s 7-D	11-v 5-D	18-r 7-C	20-s 8-D
58	21-l 8-A	17-g 7-C	3-w 1-B	25-b 9-B
59	18-c 7-D	12-u 5-D	18-q 7-C	12-r 5-C
60	12-w 5-B	17-i 7-E	21-e 8-B	9-v 4-D
61	17-o 7-C	*21-p 8-C	12-c 5-D	17-q 7-C
62	*25-v 9-D	12-h 5-E	18-j 7-A	4-t 2-D
63	18-n 7-B	25-a 9-B	11-x 5-D	*20-p 8-C
64	3-f 1-A	#0-s 1-D	20-b 8-B	3-j 1-A
65		4-m 2-B		17-u 7-D

APPENDIX G - EQUIVALENT METHOD of VIEWER RANDOMIZATION

This appendix presents a method of viewer randomization that is equivalent to that proposed in Section 2.9.2 of the Subjective Test Plan. The new method permits gradual viewer recruiting through sequential assignment to random teams and viewing positions. This method was discussed and accepted by the full Working Group at the November 10, 1993 meeting in San Jose, CA.

At the time this appendix was prepared, it was known that each lab would have all 12 subjective viewing tapes at the same time. Therefore, it is possible to randomize the tape teams (RED, GREEN, and ORANGE) and their respective random orderings (e.g. 1423 2134 3214 etc.) and assign a particular sub-team (e.g. G1 G4 G2 G3) to a viewer as he is recruited. This preserves the balance achieved through randomization and allows the labs to go forward with the testing while the recruiting process continues.

The same random numbers that appear in Table 7 of Section 2.9.2 will be used. They will now be used to order the sub-teams, however, instead of the viewers. The viewers will receive numbers from the Table 7 as they are recruited (or scheduled).

Each viewer will be given a number from Table 7 assigning each to a sub-team and seat position. The assignment will be made according to Table 7 (for each lab) proceeding down the columns and disregarding any numbers beyond 36 (or beyond the expected number of viewers). For example, the first-recruited subject for Lab X will be viewer #8 and the second-recruited subject for Lab X will be viewer #3.

Each sub-team is composed of three viewers and hence will have three numbers associated with it (one for the viewer assigned to the Left seat, one for the Center seat, and one for the Right seat). Within each sub-team of three subjects the first-listed subject will sit in the Left chair in each session, the second-listed subject will sit in the Center chair, and the third-listed subject will sit in the Right chair. For example:

Viewer Numberings for LabX		Viewer Numberings for LabY	
Viewer Number L C R	Subteam (tape order)	Viewer Number L C R	Subteam (tape order)
1,2,3	G1G4G2G3	1,2,3	03010204
4,5,6	G2G1G3G4	4,5,6	04010203
7,8,9	G3G2G1G4	7,8,9	01020304
.		Etc.	
.			
.			
34,35,36	R3R4R1R2		

Accordingly, the first-recruited subject for Lab X (Viewer #8) will be assigned the sub-team G3G2G1G4 and will sit in the Center seat. Similarly, the second-recruited subject (Viewer #3) will be assigned to sub-team G1G4G2G3 and will sit in the Right seat.

In order to facilitate scheduling subjects, substitutions may be allowed within sub-teams of the same "color" (R,G,O), but not across "colors." For example, if the viewer assigned to sub-team/seat number 2 (i.e. viewer #2), and scheduled to view tapes G1G4G2G3, was not able to make the scheduled showing, the lab could fill the vacant slot with any other

viewer who was scheduled to view GREEN tapes. However, no more than three such substitutions will be allowed within any color group.

This simpler and potentially more convenient way to randomize viewers is expected to facilitate completion of the testing in a timely manner.

APPENDIX H - CRITERIA AND THRESHOLDS FOR NORMAL VISION

This appendix gives the criteria used to determine whether or not each candidate viewer possesses normal vision. The test plan requires use of scores from only those viewers determined to have normal visual acuity and color discrimination. The scores of viewers who fail either the acuity or color tests are set aside from the main analysis.

When attempting to determine the normal threshold scores on the acuity tests, it was found that a consensus did not exist among the optometrists consulted. Furthermore, the composition of color vision test materials vary by supplier and the normal vision thresholds vary by specific test. This appendix documents the thresholds (and tests) that were used in association with this test plan.

The table below defines normal vision for the purpose of this test program.

CRITERIA	LAB	THRESHOLD SCORES
Acuity at 6H (seated)	ITS	zero errors on line 7 (20/25 or better)
Acuity at 6H (seated)	GTE	zero errors on line 7 (20/25 or better)
Acuity at 6H seated standing	DIS/NCS	zero errors on line 7 ≤1 error on line 7
Color Discrimination		
Pseudo-Isochromatic Plates for Testing Color Perception	ITS	≥5 correct out of 7 (sub-set of plates: 86, 15, 56, 57, 56, 47, 74)
Pseudo-Isochromatic Plates for Testing Color Perception	GTE	≥15 correct out of 18 (complete set of plates)
Pseudo-Isochromatic Plates for Testing Color Perception	DIS/NCS	≥10 correct out of 14 (complete set of plates)

APPENDIX C

T1A1.5 SUBJECTIVE TESTING

COMMITTEE T1

CONTRIBUTION

Document Number: T1A1.5/94-119R1

****

STANDARDS PROJECT: Analog Interface Performance Specifications for Digital Video Teleconferencing/Video Telephony Service

****

TITLE: NTIA/ITS Subjective Test Data

****

ISSUE ADDRESSED: T1A1.5 Subjective Testing

****

SOURCE: National Telecommunications and Information Administration

Institute for Telecommunication Sciences

Margaret Pinson & Coleen Jones

****

DATE: 28 March 1994

****

DISTRIBUTION TO: T1A1.5

****

KEYWORDS: Video Quality, Video Performance Specifications, Objective Quality, Subjective Quality

****

DISCLAIMER:

****

1. Introduction

The Institute for Telecommunication Sciences has completed subjective testing of the T1A1.5 video. As required by the Subjective Test Plan (T1A1.5/93-014 R5), both the raw subjective test scores and summary data have been made available to T1A1.5 participants. This document describes how to access the data and provides a summary of the data.

2. Data Access

The data has been posted on a Unix workstation at ITS. It can be accessed in the following manner from any computer with Internet access:

ftp ntia.its.bldrdoc.gov

Name: **anonymous**

Password: **<Your email address>**

ftp> **cd dist/t1a1/subjective**

ftp> **ascii**

ftp> **get <filename>**

ftp> **bye**

It is suggested that the files be transferred using ascii mode to prevent transmission errors. The read.me file contains a complete description of all the subjective data files available for transfer. A description of each file is also included as part of this document.

The following files are available in this directory:

DEMOG	Demographics Information for all viewers
QUALIFY	Viewers scores, NULL checks & repeat checks excluded.
REPEAT	Viewers scores, repeat checks only.
SCORES	All viewers scores, including order viewed information
SUMMARY1	Summary of all HRCs, scenes 'a' through 'm'
SUMMARY2	Summary of all HRCs, scenes 'n' through 'y'
read.me	"Read me" information file
scenes	Scene name to letter cross reference
HRC.01	HRC 1 summary table: viewers' scores + summary statistics
HRC.02	HRC 2 summary table: viewers' scores + summary statistics
HRC.03	HRC 3 summary table: viewers' scores + summary statistics
HRC.04	HRC 4 summary table: viewers' scores + summary statistics
HRC.05	HRC 5 summary table: viewers' scores + summary statistics
HRC.06	HRC 6 summary table: viewers' scores + summary statistics
HRC.07	HRC 7 summary table: viewers' scores + summary statistics
HRC.08	HRC 8 summary table: viewers' scores + summary statistics
HRC.09	HRC 9 summary table: viewers' scores + summary statistics
HRC.10	HRC 10 summary table: viewers' scores + summary statistics
HRC.11	HRC 11 summary table: viewers' scores + summary statistics

HRC.12	HRC 12 summary table: viewers' scores + summary statistics
HRC.13	HRC 13 summary table: viewers' scores + summary statistics
HRC.14	HRC 14 summary table: viewers' scores + summary statistics
HRC.15	HRC 15 summary table: viewers' scores + summary statistics
HRC.16	HRC 16 summary table: viewers' scores + summary statistics
HRC.17	HRC 17 summary table: viewers' scores + summary statistics
HRC.18	HRC 18 summary table: viewers' scores + summary statistics
HRC.19	HRC 19 summary table: viewers' scores + summary statistics
HRC.20	HRC 20 summary table: viewers' scores + summary statistics
HRC.21	HRC 21 summary table: viewers' scores + summary statistics
HRC.22	HRC 22 summary table: viewers' scores + summary statistics
HRC.23	HRC 23 summary table: viewers' scores + summary statistics
HRC.24	HRC 24 summary table: viewers' scores + summary statistics
HRC.25	HRC 25 summary table: viewers' scores + summary statistics

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3. Data Summary

3.1 Read.me File

A "READ.ME" file is included which briefly describes the contents of each file. This readme file is similar in content to this paper.

3.2 Subjective Test Results Summary

Files 'SUMMARY1' and 'SUMMARY2' display the mean, standard deviation, standard error, minimum, and maximum score values for each scene/HRC combination. The ten qualifying viewers' scores were used for these calculations. These statistics are displayed to three decimal places in the table. Information is split into two files. The first file, 'SUMMARY1', contains summary information for scenes A through M; the second file, 'SUMMARY2', contains summary information for scenes N through Y.

These files are listed below on facing pages, for your convenience.

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
1	MEAN	4.90	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.90	5.00	5.00	5.00	5.00
	S.D.	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00
	S.E.	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00
	MAX	5	5	5	5	5	5	5	5	5	5	5	5	5
	MIN	4	5	5	5	5	5	5	5	4	5	5	5	5

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
2	MEAN	4.30	4.10	3.50	4.30	4.60	4.20	4.30	4.20	4.30	4.20	4.50	4.60	5.00
	S.D.	0.82	0.74	0.85	0.82	0.52	0.79	0.67	0.63	0.48	0.63	0.53	0.52	0.00
	S.E.	0.26	0.23	0.27	0.26	0.16	0.25	0.21	0.20	0.15	0.20	0.17	0.16	0.00
	MAX	5	5	5	5	5	5	5	5	5	5	5	5	5
	MIN	3	3	2	3	4	3	3	3	4	3	4	4	5

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
3	MEAN	4.90	5.00	4.80	5.00	4.90	5.00	5.00	4.80	4.80	5.00	5.00	5.00	5.00
	S.D.	0.32	0.00	0.42	0.00	0.32	0.00	0.00	0.42	0.42	0.00	0.00	0.00	0.00
	S.E.	0.10	0.00	0.13	0.00	0.10	0.00	0.00	0.13	0.13	0.00	0.00	0.00	0.00
	MAX	5	5	5	5	5	5	5	5	5	5	5	5	5
	MIN	4	5	4	5	4	5	5	4	4	5	5	5	5

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
4	MEAN	3.05	2.60	2.65	2.60	2.10	3.05	2.65	1.90	1.25	3.10	3.50	3.60	1.90
	S.D.	0.89	0.94	0.75	0.99	0.85	0.76	0.81	0.72	0.44	0.64	0.61	0.75	0.85
	S.E.	0.20	0.21	0.17	0.22	0.19	0.17	0.18	0.16	0.10	0.14	0.14	0.17	0.19
	MAX	4	4	4	4	4	4	4	3	2	4	4	5	4
	MIN	1	1	1	1	1	1	1	1	1	2	2	2	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
5	MEAN	3.50	3.10	2.80	3.10	3.00	3.60	3.10	2.60	1.50	3.40	3.80	4.00	2.90
	S.D.	0.85	0.74	0.79	0.88	0.82	0.70	0.88	0.70	0.85	0.52	0.63	0.47	0.88
	S.E.	0.27	0.23	0.25	0.28	0.26	0.22	0.28	0.22	0.27	0.16	0.20	0.15	0.28
	MAX	5	4	4	4	4	5	4	3	3	4	5	5	4
	MIN	2	2	1	1	2	3	2	1	1	3	3	3	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
1	MEAN	5.00	4.80	5.00	4.90	5.00	4.40	5.00	5.00	4.90	5.00	5.00	4.90
	S.D.	0.00	0.42	0.00	0.32	0.00	0.97	0.00	0.00	0.32	0.00	0.00	0.32
	S.E.	0.00	0.13	0.00	0.10	0.00	0.31	0.00	0.00	0.10	0.00	0.00	0.10
	MAX	5	5	5	5	5	5	5	5	5	5	5	5
	MIN	5	4	5	4	5	2	5	5	4	5	5	4

HRC		n	o	p	q	r	s	t	u	v	w	x	y
2	MEAN	4.70	4.90	4.30	4.60	4.50	4.20	4.60	4.20	4.00	4.10	4.20	4.60
	S.D.	0.48	0.32	0.67	0.97	0.71	0.63	0.52	0.63	0.94	0.74	0.63	0.52
	S.E.	0.15	0.10	0.21	0.31	0.22	0.20	0.16	0.20	0.30	0.23	0.20	0.16
	MAX	5	5	5	5	5	5	5	5	5	5	5	5
	MIN	4	4	3	2	3	3	4	3	2	3	3	4

HRC		n	o	p	q	r	s	t	u	v	w	x	y
3	MEAN	5.00	4.80	4.60	4.90	5.00	4.80	5.00	4.80	4.60	4.80	5.00	4.50
	S.D.	0.00	0.42	0.70	0.32	0.00	0.42	0.00	0.42	0.97	0.42	0.00	0.53
	S.E.	0.00	0.13	0.22	0.10	0.00	0.13	0.00	0.13	0.31	0.13	0.00	0.17
	MAX	5	5	5	5	5	5	5	5	5	5	5	5
	MIN	5	4	3	4	5	4	5	4	2	4	5	4

HRC		n	o	p	q	r	s	t	u	v	w	x	y
4	MEAN	1.60	2.75	2.30	1.30	1.70	1.30	1.45	3.50	2.20	2.70	2.80	1.50
	S.D.	0.75	0.91	0.80	0.73	0.80	0.57	0.60	0.61	0.89	0.80	0.89	0.76
	S.E.	0.17	0.20	0.18	0.16	0.18	0.13	0.14	0.14	0.20	0.18	0.20	0.17
	MAX	3	4	4	3	3	3	3	4	4	4	4	3
	MIN	1	1	1	1	1	1	1	2	1	1	1	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
5	MEAN	2.20	3.20	3.50	2.30	2.60	1.60	1.80	3.70	3.50	2.60	3.00	2.70
	S.D.	0.63	0.63	0.53	0.67	0.97	0.70	0.79	0.48	0.71	0.84	0.67	0.67
	S.E.	0.20	0.20	0.17	0.21	0.31	0.22	0.25	0.15	0.22	0.27	0.21	0.21
	MAX	3	4	4	3	4	3	3	4	5	4	4	4
	MIN	1	2	3	1	1	1	1	3	3	1	2	2

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
6	MEAN	3.10	2.30	2.30	2.50	1.90	3.40	2.10	2.00	1.20	2.80	3.00	3.40	1.50
	S.D.	0.57	0.48	0.82	0.85	0.74	0.70	0.57	0.82	0.42	0.63	0.47	0.70	0.71
	S.E.	0.18	0.15	0.26	0.27	0.23	0.22	0.18	0.26	0.13	0.20	0.15	0.22	0.22
	MAX	4	3	3	4	3	5	3	3	2	4	4	4	3
	MIN	2	2	1	1	1	3	1	1	1	2	2	2	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
7	MEAN	4.10	2.80	2.80	3.30	3.40	4.10	3.60	3.10	1.90	4.00	4.10	4.20	2.70
	S.D.	0.57	0.63	0.63	0.67	0.84	0.32	0.52	0.57	0.88	0.67	0.74	0.63	0.67
	S.E.	0.18	0.20	0.20	0.21	0.27	0.10	0.16	0.18	0.28	0.21	0.23	0.20	0.21
	MAX	5	4	4	4	4	5	4	4	3	5	5	5	4
	MIN	3	2	2	2	2	4	3	2	1	3	3	3	2

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
8	MEAN	4.10	3.70	3.30	3.40	3.40	4.00	3.90	2.80	1.90	4.20	4.20	4.30	3.30
	S.D.	0.74	0.48	0.82	0.70	0.84	0.47	0.57	0.63	0.99	0.63	0.42	0.48	0.48
	S.E.	0.23	0.15	0.26	0.22	0.27	0.15	0.18	0.20	0.31	0.20	0.13	0.15	0.15
	MAX	5	4	4	4	5	5	5	4	4	5	5	5	4
	MIN	3	3	2	2	2	3	3	2	1	3	4	4	3

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
9	MEAN	4.40	3.20	2.20	3.80	2.90	4.60	4.40	2.80	2.00	3.90	4.50	4.30	3.00
	S.D.	0.70	0.92	0.63	0.42	0.88	0.52	0.52	0.92	0.94	0.57	0.71	0.67	1.15
	S.E.	0.22	0.29	0.20	0.13	0.28	0.16	0.16	0.29	0.30	0.18	0.22	0.21	0.37
	MAX	5	5	3	4	4	5	5	4	3	5	5	5	4
	MIN	3	2	1	3	1	4	4	1	1	3	3	3	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
10	MEAN	4.90	3.80	3.10	3.40	3.80	4.40	4.20	3.20	2.40	4.30	4.40	4.70	3.60
	S.D.	0.32	0.79	0.88	0.52	0.79	0.70	0.63	0.63	0.97	0.48	0.52	0.48	0.70
	S.E.	0.10	0.25	0.28	0.16	0.25	0.22	0.20	0.20	0.31	0.15	0.16	0.15	0.22
	MAX	5	5	4	4	5	5	5	4	4	5	5	5	5
	MIN	4	3	2	3	3	3	3	2	1	4	4	4	3

HRC		n	o	p	q	r	s	t	u	v	w	x	y
6	MEAN	1.50	1.90	2.70	1.30	1.80	1.20	2.30	3.20	2.50	2.10	2.00	2.20
	S.D.	0.53	0.99	0.67	0.48	0.42	0.42	0.67	0.79	0.71	0.74	0.67	0.79
	S.E.	0.17	0.31	0.21	0.15	0.13	0.13	0.21	0.25	0.22	0.23	0.21	0.25
	MAX	2	4	4	2	2	2	3	4	4	3	3	3
	MIN	1	1	2	1	1	1	1	2	2	1	1	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
7	MEAN	2.90	3.30	3.40	2.50	2.90	2.00	2.70	4.20	3.10	3.10	3.60	3.10
	S.D.	0.57	0.67	0.70	0.53	0.88	0.67	0.82	0.42	0.88	0.74	0.52	0.99
	S.E.	0.18	0.21	0.22	0.17	0.28	0.21	0.26	0.13	0.28	0.23	0.16	0.31
	MAX	4	4	4	3	4	3	4	5	5	4	4	5
	MIN	2	2	2	2	1	1	1	4	2	2	3	2

HRC		n	o	p	q	r	s	t	u	v	w	x	y
8	MEAN	3.40	3.60	3.80	3.30	3.70	2.50	3.20	4.10	3.50	4.10	4.10	3.20
	S.D.	0.70	0.52	0.63	0.67	0.48	1.08	0.42	0.32	0.53	0.74	0.32	0.92
	S.E.	0.22	0.16	0.20	0.21	0.15	0.34	0.13	0.10	0.17	0.23	0.10	0.29
	MAX	4	4	5	4	4	4	4	5	4	5	5	5
	MIN	2	3	3	2	3	1	3	4	3	3	4	2

HRC		n	o	p	q	r	s	t	u	v	w	x	y
9	MEAN	3.00	3.20	3.20	2.40	3.30	2.10	2.80	4.40	3.10	3.30	3.60	3.40
	S.D.	0.47	0.63	0.63	1.07	0.67	0.88	0.63	0.70	0.99	0.67	0.70	1.07
	S.E.	0.15	0.20	0.20	0.34	0.21	0.28	0.20	0.22	0.31	0.21	0.22	0.34
	MAX	4	4	4	4	4	3	4	5	4	4	5	5
	MIN	2	2	2	1	2	1	2	3	1	2	3	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
10	MEAN	3.90	3.50	3.50	3.20	4.10	3.00	3.00	4.70	4.40	4.30	3.90	3.70
	S.D.	0.57	0.71	0.85	0.42	0.74	0.47	0.47	0.48	0.52	0.48	0.57	0.67
	S.E.	0.18	0.22	0.27	0.13	0.23	0.15	0.15	0.15	0.16	0.15	0.18	0.21
	MAX	5	4	5	4	5	4	4	5	5	5	5	5
	MIN	3	2	2	3	3	2	2	4	4	4	3	3

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
11	MEAN	2.40	2.90	1.60	2.20	1.60	2.70	2.00	2.00	1.30	1.90	2.90	1.90	1.40
	S.D.	0.84	0.74	0.52	0.92	0.70	0.82	1.05	0.82	0.48	0.88	0.88	0.74	0.52
	S.E.	0.27	0.23	0.16	0.29	0.22	0.26	0.33	0.26	0.15	0.28	0.28	0.23	0.16
	MAX	4	4	2	3	3	4	4	3	2	3	4	3	2
	MIN	1	2	1	1	1	1	1	1	1	1	1	1	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
12	MEAN	2.10	2.30	1.40	2.30	1.60	2.60	2.40	1.80	1.00	2.30	2.70	2.90	1.50
	S.D.	0.74	1.16	0.52	0.95	1.07	0.84	0.97	0.63	0.00	0.95	0.82	0.57	0.53
	S.E.	0.23	0.37	0.16	0.30	0.34	0.27	0.31	0.20	0.00	0.30	0.26	0.18	0.17
	MAX	3	4	2	4	4	4	4	3	1	4	4	4	2
	MIN	1	1	1	1	1	1	1	1	1	1	1	2	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
13	MEAN	2.10	1.60	1.30	1.90	1.50	2.00	1.60	2.00	1.50	2.40	2.70	3.00	1.80
	S.D.	0.88	0.70	0.48	0.57	0.85	0.67	0.70	0.94	0.85	0.52	0.48	0.67	0.79
	S.E.	0.28	0.22	0.15	0.18	0.27	0.21	0.22	0.30	0.27	0.16	0.15	0.21	0.25
	MAX	4	3	2	3	3	3	3	3	3	3	3	4	3
	MIN	1	1	1	1	1	1	1	1	1	2	2	2	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
14	MEAN	1.40	1.90	1.50	2.00	1.90	1.90	2.10	2.00	1.80	3.00	2.40	2.80	2.80
	S.D.	0.52	0.88	0.71	0.82	0.74	0.57	0.88	0.67	0.63	0.67	0.70	0.63	0.79
	S.E.	0.16	0.28	0.22	0.26	0.23	0.18	0.28	0.21	0.20	0.21	0.22	0.20	0.25
	MAX	2	3	3	3	3	3	3	3	3	4	3	4	4
	MIN	1	1	1	1	1	1	1	1	1	2	1	2	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
15	MEAN	2.60	2.25	1.75	1.68	1.35	2.90	1.85	1.80	1.30	2.15	2.75	1.80	1.35
	S.D.	0.75	0.64	0.64	0.58	0.59	0.45	0.75	0.70	0.57	0.67	0.55	0.70	0.59
	S.E.	0.17	0.14	0.14	0.13	0.13	0.10	0.17	0.16	0.13	0.15	0.12	0.16	0.13
	MAX	4	3	3	3	3	4	3	3	3	3	3	3	3
	MIN	1	1	1	1	1	2	1	1	1	1	1	1	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
11	MEAN	1.40	2.20	2.10	1.10	1.40	1.30	1.20	1.90	1.20	1.80	1.80	1.40
	S.D.	0.52	0.79	0.74	0.32	0.70	0.48	0.42	0.99	0.42	0.92	0.63	0.70
	S.E.	0.16	0.25	0.23	0.10	0.22	0.15	0.13	0.31	0.13	0.29	0.20	0.22
	MAX	2	3	3	2	3	2	2	3	2	3	3	3
	MIN	1	1	1	1	1	1	1	1	1	1	1	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
12	MEAN	1.30	2.20	3.20	1.50	1.10	1.30	1.10	1.80	1.00	2.10	2.50	1.30
	S.D.	0.48	0.63	0.63	0.85	0.32	0.48	0.32	0.63	0.00	0.74	1.08	0.67
	S.E.	0.15	0.20	0.20	0.27	0.10	0.15	0.10	0.20	0.00	0.23	0.34	0.21
	MAX	2	3	4	3	2	2	2	3	1	3	4	3
	MIN	1	1	2	1	1	1	1	1	1	1	1	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
13	MEAN	2.20	2.00	2.00	1.20	1.50	1.60	1.70	1.80	1.30	1.80	2.10	1.90
	S.D.	0.92	0.82	0.94	0.42	0.71	0.70	0.67	0.63	0.48	0.79	0.99	0.74
	S.E.	0.29	0.26	0.30	0.13	0.22	0.22	0.21	0.20	0.15	0.25	0.31	0.23
	MAX	3	3	3	2	3	3	3	3	2	3	4	3
	MIN	1	1	1	1	1	1	1	1	1	1	1	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
14	MEAN	2.70	1.80	1.60	1.60	2.00	1.70	1.60	1.60	1.70	2.00	2.20	2.80
	S.D.	0.82	0.63	0.70	0.70	0.82	0.67	0.52	0.84	0.82	0.94	0.92	0.63
	S.E.	0.26	0.20	0.22	0.22	0.26	0.21	0.16	0.27	0.26	0.30	0.29	0.20
	MAX	4	3	3	3	3	3	2	3	3	3	3	4
	MIN	1	1	1	1	1	1	1	1	1	1	1	2

HRC		n	o	p	q	r	s	t	u	v	w	x	y
15	MEAN	1.25	1.45	1.85	1.15	1.45	1.40	1.30	2.55	1.35	2.00	1.30	1.40
	S.D.	0.44	0.60	0.75	0.37	0.69	0.60	0.47	0.51	0.49	0.73	0.47	0.68
	S.E.	0.10	0.14	0.17	0.08	0.15	0.13	0.11	0.11	0.11	0.16	0.11	0.15
	MAX	2	3	3	2	3	3	2	3	2	3	2	3
	MIN	1	1	1	1	1	1	1	2	1	1	1	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
16	MEAN	2.80	2.80	2.30	2.20	1.70	2.60	2.50	2.20	1.20	2.40	2.40	2.60	1.30
	S.D.	0.79	0.92	0.82	0.63	0.67	0.52	0.85	1.23	0.42	0.84	0.97	0.70	0.67
	S.E.	0.25	0.29	0.26	0.20	0.21	0.16	0.27	0.39	0.13	0.27	0.31	0.22	0.21
	MAX	4	4	4	3	3	3	4	4	2	4	4	3	3
	MIN	2	2	1	1	1	2	1	1	1	1	1	1	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
17	MEAN	3.25	2.90	2.25	2.40	1.70	3.35	2.60	2.20	1.50	2.30	3.15	3.00	1.55
	S.D.	0.72	0.85	0.97	0.82	0.73	0.59	0.82	0.83	0.76	0.92	0.67	0.73	0.51
	S.E.	0.16	0.19	0.22	0.18	0.16	0.13	0.18	0.19	0.17	0.21	0.15	0.16	0.11
	MAX	4	4	4	4	3	4	4	4	4	4	5	4	2
	MIN	2	1	1	1	1	2	1	1	1	1	2	2	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
18	MEAN	4.30	2.70	2.40	2.80	2.50	4.20	3.60	2.20	1.20	2.90	3.40	3.90	1.60
	S.D.	0.67	0.82	0.84	0.79	0.85	0.63	0.70	0.79	0.42	0.74	0.52	0.57	0.70
	S.E.	0.21	0.26	0.27	0.25	0.27	0.20	0.22	0.25	0.13	0.23	0.16	0.18	0.22
	MAX	5	4	4	4	4	5	5	3	2	4	4	5	3
	MIN	3	2	1	1	1	3	3	1	1	2	3	3	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
19	MEAN	3.60	2.60	2.00	2.90	2.50	3.70	3.50	2.40	1.80	3.10	3.20	3.80	1.80
	S.D.	0.52	0.84	0.82	0.57	0.85	0.48	0.53	0.70	0.79	0.74	0.42	0.63	0.92
	S.E.	0.16	0.27	0.26	0.18	0.27	0.15	0.17	0.22	0.25	0.23	0.13	0.20	0.29
	MAX	4	4	3	4	4	4	4	3	3	4	4	5	3
	MIN	3	1	1	2	1	3	3	1	1	2	3	3	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
20	MEAN	4.40	3.73	2.97	3.47	3.43	4.40	3.87	2.67	1.87	3.70	4.10	4.03	2.63
	S.D.	0.62	0.87	0.67	0.63	0.90	0.50	0.57	1.03	0.82	0.53	0.61	0.49	0.81
	S.E.	0.11	0.16	0.12	0.11	0.16	0.09	0.10	0.19	0.15	0.10	0.11	0.09	0.15
	MAX	5	5	4	5	5	5	5	4	4	5	5	5	4
	MIN	3	1	1	2	1	4	3	1	1	3	3	3	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
16	MEAN	1.20	1.20	1.60	1.20	2.10	1.50	1.50	2.30	2.20	1.90	1.40	1.20
	S.D.	0.42	0.42	0.70	0.42	1.20	0.71	0.53	0.82	0.92	0.74	0.52	0.42
	S.E.	0.13	0.13	0.22	0.13	0.38	0.22	0.17	0.26	0.29	0.23	0.16	0.13
	MAX	2	2	3	2	4	3	2	3	4	3	2	2
	MIN	1	1	1	1	1	1	1	1	1	1	1	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
17	MEAN	1.80	2.15	2.60	1.60	1.85	1.90	2.20	3.00	1.85	2.60	2.45	1.55
	S.D.	0.77	0.88	0.68	0.75	0.88	0.72	0.52	0.73	0.81	0.75	0.69	0.60
	S.E.	0.17	0.20	0.15	0.17	0.20	0.16	0.12	0.16	0.18	0.17	0.15	0.14
	MAX	3	4	4	3	4	3	3	4	3	4	3	3
	MIN	1	1	1	1	1	1	1	2	1	2	1	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
18	MEAN	1.50	2.30	3.30	1.70	1.60	1.30	1.50	3.40	1.10	2.90	2.80	1.40
	S.D.	0.71	0.95	0.48	0.82	0.52	0.48	0.71	0.70	0.32	0.99	0.92	0.70
	S.E.	0.22	0.30	0.15	0.26	0.16	0.15	0.22	0.22	0.10	0.31	0.29	0.22
	MAX	3	4	4	3	2	2	3	4	2	4	4	3
	MIN	1	1	3	1	1	1	1	2	1	1	1	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
19	MEAN	2.30	2.50	3.10	1.20	2.40	1.90	2.60	3.90	2.30	2.50	3.20	2.30
	S.D.	0.67	0.71	0.74	0.42	0.70	0.88	0.52	0.32	0.67	0.71	0.42	0.67
	S.E.	0.21	0.22	0.23	0.13	0.22	0.28	0.16	0.10	0.21	0.22	0.13	0.21
	MAX	3	3	4	2	4	3	3	4	3	3	4	4
	MIN	1	1	2	1	2	1	2	3	1	1	3	2

HRC		n	o	p	q	r	s	t	u	v	w	x	y
20	MEAN	2.13	3.17	3.70	2.50	3.23	3.17	2.97	4.03	3.17	3.57	3.57	2.70
	S.D.	0.86	0.87	0.65	0.86	0.73	0.99	0.85	0.56	0.53	0.73	0.57	0.92
	S.E.	0.16	0.16	0.12	0.16	0.13	0.18	0.16	0.10	0.10	0.13	0.10	0.17
	MAX	4	4	5	4	4	5	4	5	4	5	5	5
	MIN	1	1	2	1	2	1	2	3	2	2	3	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
21	MEAN	3.40	2.90	3.10	2.80	2.70	2.80	3.10	3.30	1.70	3.00	3.20	3.30	2.40
	S.D.	0.70	0.74	0.74	0.79	0.82	0.92	0.74	0.95	0.82	1.15	0.63	0.82	0.84
	S.E.	0.22	0.23	0.23	0.25	0.26	0.29	0.23	0.30	0.26	0.37	0.20	0.26	0.27
	MAX	4	4	4	4	4	4	4	4	3	4	4	4	4
	MIN	2	2	2	1	2	1	2	1	1	1	2	2	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
22	MEAN	4.30	3.30	3.10	4.00	4.00	4.70	4.40	3.00	3.10	4.30	4.20	4.40	3.40
	S.D.	0.48	0.67	0.57	0.67	0.67	0.48	0.52	0.67	0.57	0.67	0.42	0.52	0.70
	S.E.	0.15	0.21	0.18	0.21	0.21	0.15	0.16	0.21	0.18	0.21	0.13	0.16	0.22
	MAX	5	4	4	5	5	5	5	4	4	5	5	5	4
	MIN	4	2	2	3	3	4	4	2	2	3	4	4	2

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
23	MEAN	4.00	3.90	3.30	3.60	3.40	3.90	4.00	2.20	1.70	3.80	4.20	4.10	2.70
	S.D.	0.67	0.32	0.82	0.70	0.70	0.32	0.47	0.92	0.67	0.63	0.42	0.57	1.06
	S.E.	0.21	0.10	0.26	0.22	0.22	0.10	0.15	0.29	0.21	0.20	0.13	0.18	0.33
	MAX	5	4	4	4	4	4	5	3	3	5	5	5	5
	MIN	3	3	2	2	2	3	3	1	1	3	4	3	1

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
24	MEAN	4.70	3.90	3.70	4.00	3.90	4.50	4.70	3.50	2.90	4.10	4.40	4.20	3.80
	S.D.	0.48	0.32	0.82	0.00	0.32	0.53	0.48	0.71	0.88	0.57	0.70	0.42	0.42
	S.E.	0.15	0.10	0.26	0.00	0.10	0.17	0.15	0.22	0.28	0.18	0.22	0.13	0.13
	MAX	5	4	5	4	4	5	5	4	4	5	5	5	4
	MIN	4	3	2	4	3	4	4	2	1	3	3	4	3

HRC		a	b	c	d	e	f	g	h	i	j	k	l	m
25	MEAN	4.00	3.80	3.60	3.70	4.00	4.00	4.10	2.90	2.80	4.10	4.30	4.10	3.50
	S.D.	0.67	0.79	0.52	0.48	0.67	0.00	0.57	0.88	0.79	0.32	0.48	0.32	0.53
	S.E.	0.21	0.25	0.16	0.15	0.21	0.00	0.18	0.28	0.25	0.10	0.15	0.10	0.17
	MAX	5	5	4	4	5	4	5	4	4	5	5	5	4
	MIN	3	2	3	3	3	4	3	1	2	4	4	4	3

HRC		n	o	p	q	r	s	t	u	v	w	x	y
21	MEAN	2.10	1.90	2.80	1.80	2.30	2.20	2.40	3.60	2.20	3.50	3.40	2.40
	S.D.	0.99	0.88	0.63	0.79	0.67	0.92	0.84	0.84	0.92	0.53	0.70	1.26
	S.E.	0.31	0.28	0.20	0.25	0.21	0.29	0.27	0.27	0.29	0.17	0.22	0.40
	MAX	4	3	4	3	3	4	4	5	4	4	4	4
	MIN	1	1	2	1	1	1	1	2	1	3	2	1

HRC		n	o	p	q	r	s	t	u	v	w	x	y
22	MEAN	3.20	3.50	3.90	3.50	3.80	1.70	3.10	4.50	4.20	3.70	3.60	4.10
	S.D.	0.42	0.71	0.32	0.53	0.63	0.95	0.74	0.53	0.79	0.67	0.70	0.88
	S.E.	0.13	0.22	0.10	0.17	0.20	0.30	0.23	0.17	0.25	0.21	0.22	0.28
	MAX	4	5	4	4	5	4	4	5	5	5	4	5
	MIN	3	3	3	3	3	1	2	4	3	3	2	3

HRC		n	o	p	q	r	s	t	u	v	w	x	y
23	MEAN	2.00	3.50	3.80	3.10	3.60	2.20	3.50	4.00	3.80	3.60	3.60	3.20
	S.D.	0.94	0.53	0.79	0.99	0.70	1.03	0.53	0.47	0.42	0.70	0.70	0.63
	S.E.	0.30	0.17	0.25	0.31	0.22	0.33	0.17	0.15	0.13	0.22	0.22	0.20
	MAX	4	4	5	5	4	4	4	5	4	4	4	4
	MIN	1	3	3	2	2	1	3	3	3	2	2	2

HRC		n	o	p	q	r	s	t	u	v	w	x	y
24	MEAN	3.90	3.70	4.10	2.80	4.00	3.20	4.30	4.60	3.90	3.90	3.90	3.70
	S.D.	0.99	0.67	0.57	0.63	0.67	0.92	0.48	0.52	0.74	0.57	0.57	0.67
	S.E.	0.31	0.21	0.18	0.20	0.21	0.29	0.15	0.16	0.23	0.18	0.18	0.21
	MAX	5	5	5	4	5	4	5	5	5	5	5	5
	MIN	2	3	3	2	3	2	4	4	3	3	3	3

HRC		n	o	p	q	r	s	t	u	v	w	x	y
25	MEAN	3.50	3.20	3.90	3.70	4.00	3.00	3.50	4.20	4.10	4.00	4.40	4.30
	S.D.	0.71	0.92	0.57	0.82	0.67	1.15	0.71	0.42	0.99	0.47	0.52	0.67
	S.E.	0.22	0.29	0.18	0.26	0.21	0.37	0.22	0.13	0.31	0.15	0.16	0.21
	MAX	4	4	5	5	5	5	4	5	5	5	5	5
	MIN	2	1	3	2	3	1	2	4	2	3	4	3

3.3 Sample HRC data

The HRC tables are separated into 25 files, each listing the scores associated with one HRC. These files are named "HRC.01", "HRC.02", "HRC.03", ... "HRC.25". The suffix number is the HRC described in this file. The format of these files is described in the subjective test plan. Notice that the summary statistics listed at the bottom of the file are computed on the 10 qualifying viewers. Scene / HRC combinations which a viewer did not score are marked with a zero (0). These scene / HRC paris are not used in the computation of summary statistics. The column "VIEWER QUALIFY" marks the validity status of each viewer: '0' for Invalid viewers; '1' for valid or qualified viewers; '*' for alternate viewers (valid but extraneous).

The contents of the ITS file HRC.20 are displayed below.

HRC NO.20

TEAM	VIEWER ID	QUALIFY	SCENE a b c d e f g h i j k l m n o p q r s t u v w x y	REPEAT o
RED	80.z	1	4 4 3 3 3 5 4 3 2 3 4 4 2 2 2 4 1 2 3 4 5 4 4 3 3	4
	09.z	1	5 3 3 4 3 4 4 2 2 4 5 4 3 2 3 3 3 4 3 2 4 3 4 3 2	3
	37.z	1	5 4 2 3 2 5 3 1 1 3 4 5 3 2 3 4 2 3 2 3 5 3 3 2	3
	39.z	1	3 4 3 3 4 4 3 2 2 4 4 4 3 2 3 3 3 3 4 4 4 4 4 4 2	3
	38.z	1	5 4 3 3 4 5 4 3 1 4 4 4 1 1 4 4 3 4 4 4 4 3 4 4 3	4
	40.z	1	4 4 3 3 3 4 3 4 4 4 4 4 3 3 3 3 3 3 4 3 4 3 4 3 5	3
	41.z	1	4 4 2 3 3 4 4 4 2 4 4 4 3 2 2 2 2 2 2 2 4 3 4 3 3	3
	43.z	1	4 4 3 4 4 4 4 2 2 4 4 4 2 1 4 4 2 4 3 3 4 3 4 4 2	4
	46.z	0	4 4 3 3 4 5 5 3 3 4 5 4 5 3 4 3 3 4 4 4 5 3 4 3 4	2
	47.z	1	5 5 3 3 3 5 4 1 2 4 3 4 3 3 2 5 3 4 3 3 4 3 3 4 4	3
	48.z	1	5 4 3 4 4 4 3 4 3 4 5 4 3 2 4 4 2 3 4 4 4 3 3 3 2	3
	06.z	*	5 3 2 3 3 4 4 2 3 3 4 3 3 2 3 3 2 3 2 3 4 3 3 3 3	3
	82.z	*	5 4 3 3 3 5 4 2 1 4 5 4 3 2 1 3 3 4 4 3 4 3 3 2 3	2
	44.z	*	5 5 3 4 4 5 5 3 3 5 5 5 3 3 4 4 4 4 4 4 5 5 4 4 4	4

TEAM	VIEWER ID	QUALIFY	SCENE a b c d e f g h i j k l m n o p q r s t u v w x y	REPEAT d	q
GREEN	13.z	1	4 2 3 4 4 5 5 3 2 3 4 4 2 1 2 3 1 3 5 2 4 3 2 4 1	1	4
	15.z	1	3 3 4 3 3 4 4 4 2 4 4 4 3 3 4 3 2 3 4 3 4 3 4 4 2	3	4
	17.z	1	5 5 3 5 5 5 4 3 1 4 5 5 3 2 4 5 2 4 4 4 4 3 4 4 3	5	2
	18.z	0	5 3 3 4 4 5 4 3 1 3 4 4 3 2 4 4 2 4 4 3 4 4 4 4 2	4	2
	90.z	1	4 4 2 4 3 4 4 1 1 3 3 3 3 1 1 3 2 3 3 4 3 3 3 3 3	3	2
	22.z	1	5 5 4 4 5 5 5 2 2 4 5 5 4 2 4 4 4 4 4 4 5 4 5 4 4	4	4
	23.z	1	5 4 4 4 5 5 4 3 1 4 5 4 2 2 3 4 3 4 3 4 4 3 4 4 2	3	4
	24.z	1	4 4 3 3 3 4 4 3 3 3 4 4 4 3 3 3 4 4 4 3 4 4 4 4 4 3	4	4
	50.z	1	4 4 3 3 3 5 4 1 1 3 4 4 2 1 2 4 2 2 3 2 4 3 2 3 2	2	3
	54.z	1	5 4 3 3 3 4 4 2 1 3 3 4 2 2 3 4 2 3 4 2 4 3 3 3 3	3	3

	55.z	1	4433344413444333343343333	3	3
	57.z	*	3333333224342233233343332	2	3
	20.z	*	3423445333443334233233443	3	4
	19.z	*	5443455224542334242454333	3	3
	21.z	*	5233444224542124324342342	2	4

	VIEWER		SCENE	REPEAT
TEAM	ID	QUALIFY	a b c d e f g h i j k l m n o p q r s t u v w x y	p
ORANGE	25.z	1	4234354425452343235253453	5
	26.z	0	2323222342432122232333312	3
	27.z	0	5424545235532423342442333	4
	28.z	1	4433344234442244243344442	3
	29.z	1	5444555324542244443444443	4
	30.z	1	5434344334543344433344433	4
	31.z	1	4313344213443123232243332	3
	32.z	0	5542255333444344251234443	4
	33.z	0	4322233112331113122133331	3
	34.z	1	5434444333444443433424343	4
	62.z	1	4434444424444244321232444	4
	63.z	1	4322153123331144122332331	4
	69.z	1	5143343314432444241253242	4
	71.z	1	5434444313442234333233434	4

	a	b	c	d	e	f	g	h	i	j	k	l	m
MEAN	4.40	3.73	2.97	3.47	3.43	4.40	3.87	2.67	1.87	3.70	4.10	4.03	2.63
S.D.	0.62	0.87	0.67	0.63	0.90	0.50	0.57	1.03	0.82	0.53	0.61	0.49	0.81
S.E.	0.11	0.16	0.12	0.11	0.16	0.09	0.10	0.19	0.15	0.10	0.11	0.09	0.15
MAX	5	5	4	5	5	5	5	4	4	5	5	5	4
MIN	3	1	1	2	1	4	3	1	1	3	3	3	1

	n	o	p	q	r	s	t	u	v	w	x	y
MEAN	2.13	3.17	3.70	2.50	3.23	3.17	2.97	4.03	3.17	3.57	3.57	2.70
S.D.	0.86	0.87	0.65	0.86	0.73	0.99	0.85	0.56	0.53	0.73	0.57	0.92
S.E.	0.16	0.16	0.12	0.16	0.13	0.18	0.16	0.10	0.10	0.13	0.10	0.17
MAX	4	4	5	4	4	5	4	5	4	5	5	5
MIN	1	1	2	1	2	1	2	3	2	2	3	1

3.4 Demographic Data

File 'DEMOG' contains demographics for each viewer. This file format is not specified in the subjective test plan. "ID" is the number and lab code associated with each viewer. NTIA / ITS is lab "z". Note that viewer numbers were not assigned sequentially. "Decade" is listed for brevity; the questionnaires listed a range of ages corresponding to that decade. "Industry" and "Job" include the entire text listed on the questionnaire. "Eye Test" is #/# where the first number is the last line of the eye chart completely read and the second number is the number of color plates missed. NTIA/ITS viewers were allowed to miss 2 of 8 color plates.

The entire contents of the NTIA / ITS demographics file are listed below.

RED TEAM

ID	DECADE	GENDER	INDUSTRY	JOB	PAST VIDEO	EYE TEST	SESSION SEAT	SESSION ORDER
80.z	30	female	Government	Technical	Recent	9/2	center	2431
09.z	50	male	Government	Professional	No	9/0	right	2431
37.z	50	male	Government	Executive/ Managerial	Yes	9/2	left	3142
39.z	40	female	Government	Professional	Yes	8/2	right	3142
38.z	40	male	Government	Technical	No	9/1	center	3142
40.z	40	female	Government	Administrative/ White Collar	No	9/1	left	2413
41.z	30	male	Government	Technical	Recent	9/0	center	2413
43.z	40	male	Engineering/ Architecture	Technical	No	10/0	left	2431
46.z	60	male	Government	Laborer	No	7/2	left	4231
47.z	50	male	Electronics/ Computers	Professional	Recent	9/1	center	4231
48.z	20	female	Electronics/ Computers	Technical	Recent	8/2	right	4231
06.z	30	male	Telecommunication/ Utilities	Technical	No	8/0	right	2413
82.z	60	male	Government	Executive/ Managerial	Recent	9/1	left	4231
44.z	60	female	Government	Secretarial	No	7/1	center	2431

GREEN TEAM

ID	DECADE	GENDER	INDUSTRY	JOB	PAST VIDEO	EYE TEST	SESSION SEAT	SESSION ORDER
13.z	40	male	Government	Technical	No	9/1	left	4321
15.z	30	female	Government	Secretarial	No	8/1	right	4321
17.z	40	female	Personal/	Administrative/	No	8/2	right	1243

18.z	50	male	Business Services Electronics/ Computers	White Collar Administrative/ White Collar	Yes	7/4	right	1243
90.z	30	male	Engineering/ Architecture	Professional	Yes	10/1	right	1243
22.z	40	male	Government	Technical	Recent	8/1	left	2341
23.z	50	male	Government	Executive/ Managerial	Recent	9/1	center	2341
24.z	50	male	Government	Administrative/ White Collar	No	9/1	right	2341
50.z	60	male	Government Managerial	Executive/	Recent	9/1	center	4321
54.z	60	male	Electronics/ Computers	Executive/ Managerial	Recent	7/1	right	1243
55.z	30	male	Government Support	Clerical/	No	9/2	left	2431
57.z	30	male	Telecommunication/ Utilities	Technical	Yes	9/0	right	2431
20.z	40	male	Electronics/ Computers	Professional	No	8/0	center	2431
19.z	40	male	Telecommunication/ Utilities	Technical	Recent	7/1	left	2431
21.z	70	male	Government Support	Clerical/	No	7/2	right	2431

ORANGE TEAM

ID	DECADE	GENDER	INDUSTRY	JOB	PAST VIDEO	EYE TEST	SESSION SEAT	ORDER
25.z	40	male	Engineering/ Architecture	Administrative/ White Collar	No	10/0	left	1324
26.z	20	female	Government	Administrative/ White Collar	Recent	10/0	center	1324
27.z	50	female	Government	Clerical/ Support	No	9/1	right	1324
28.z	30	male	Electronics/ Computers	Technical	No	10/1	left	4132
29.z	50	male	Government	Clerical/ Support	Recent	8/0	center	4132
30.z	50	male	Government	Technical	No	9/1	right	4132
31.z	30	male	Government	Technical	No	8/0	left	4312
32.z	50	female	Government	Professional	Recent	8/2	center	4312
33.z	30	male	Engineering/ Architecture	Executive/ Managerial	Recent	6/1	right	4312
34.z	40	female	Government	Administrative/ White Collar	No	9/2	left	3241
62.z	30	female	Government	Secretarial	No	9/0	center	1324
63.z	20	male	Government	Technical	No	10/0	right	1324
69.z	50	female	Government	Administrative/ White Collar	No	10/1	right	4312
71.z	40	male	Military	Police/ Military	Recent	9/0	center	3241

3.5 Raw Scores File

The file 'SCORES' contains all scores for all viewers listed one per line, in a format suitable for loading into S.A.S. or similar statistical packages. This file contains for each viewer, the following five columns:

<viewer> <order> <hrc> <scene> <rating>

<viewer> is the viewer's number and lab affiliation letter. <order> is the order in which the viewer saw the 258 or 260 scene / HRC pairs. <hrc> is the number, '0' through '25', of the current HRC. HRC '0' marks NULL checks. <scene> is the letter, 'a' through 'y' of the current scene. <rating> is the rating given to this scene / hrc pair by the viewer. '5' is Imperceptible; '4' is Perceptible but not Annoying; '3' is Slightly Annoying; '2' is Annoying; and '1' is Very Annoying. A zero in this column marks unrated scene / HRC pairs.

File SCORES includes all scene / HRC pairs viewed. Note that consistency checks will appear twice for each viewer and that NULL checks are included. Also note that all viewers' data are listed in this file regardless of whether the viewer is valid, invalid, or extra.

3.6 Qualifying Scores File

The file 'QUALIFY' contains all scores, except NULL checks and repeat quality checks, for all viewers listed one per line, in a format suitable for loading into S.A.S. or similar statistical packages. This file contains for each viewer, the following four columns:

<viewer> <hrc> <scene> <rating>

<viewer> is the viewer's number and lab affiliation letter. <hrc> is the number, '1' through '25', of the current HRC. <scene> is the letter, 'a' through 'y' of the current scene. <rating> is the rating given to this scene / hrc pair by the viewer. '5' is Imperceptible; '4' is Perceptible but not Annoying; '3' is Slightly Annoying; '2' is Annoying; and '1' is Very Annoying. A zero in this column marks unrated scene / HRC combinations.

File QUALIFY includes all scene / HRC pairs viewed. Also note that all viewers' data are listed in this file regardless of whether the viewer is valid, invalid, or extra.

3.7 Repeat Check Scores File

The file 'REPEAT' contains repeat quality check scores for all viewers listed one per line, in a format suitable for loading into S.A.S. or similar statistical packages. This file contains for each viewer, the following four columns:

<viewer> <hrc> <scene> <rating> <order>

<viewer> is the viewer's number and lab affiliation letter. <hrc> is the number, '1' through '25', of the current HRC. <scene> is the letter, 'a' through 'y' of the current scene. <rating> is the rating given to this scene / hrc pair by the viewer. '5' is Imperceptible; '4' is Perceptible but not Annoying; '3' is Slightly Annoying; '2' is Annoying; and '1' is Very Annoying. A zero in this column marks unrated scene / HRC combinations. <order> is

the order in which the repeat checks were viewed. '1' marks the first viewed; '2' marks the second viewed.

File REPEAT includes all scene / HRC repeat check pairs. Also note that all viewers' data are listed in this file regardless of whether the viewer is valid, invalid, or extra.

3.8 Raw Data Directory

Directory "raw" contains the ratings and demographic data for each viewer in an unformatted state.